UNION PUBLIC SERVICE COMMISSION

EXAMINATION NOTICE NO. 07/2019-GEOL **Dated 20.03.2019**

(LAST DATE FOR SUBMISSION OF APPLICATIONS : 16.04.2019

COMBINED GEO-SCIENTIST AND GEOLOGIST EXAMINATION, 2019

(COMMISSION'S WEBSITE: www.upsc.gov.in)

IMPORTANT

1. CANDIDATES TO ENSURE THEIR ELIGIBILITIY FOR THE EXAMINATION:

Candidates applying for the examination should ensure that they fulfil all eligibility conditions for admission to the Examination. Their admission at all the stages of the examination will be purely provisional subject to satisfying the prescribed eligibility conditions.

Mere issue of Admission Certificate to the candidate will not imply that his/her candidature has been finally cleared by the Commission.

Verification of eligibility conditions with reference to original documents is taken up only after the candidate has qualified for Interview/Personality Test.

2. HOW TO APPLY :

Candidates are required to apply online only by using the website http://www.upsconline.nic.in Brief instructions for filling up the online Application Form have been given in Appendix-II. Detailed instructions are available on the above mentioned website.

2.1 Candidate should have details of one Photo ID Card viz. Aadhaar Card/Voter Card/PAN Card/Passport/Driving Licence/Any other Photo ID Card issued by the State/Central Government. The details of this Photo ID Card will have to be provided by the candidate while filling up the online application form. The candidates will have to upload a scanned copy of the Photo ID whose details have been provided in the online application by him/her. This Photo ID Card will be used for all future referencing and the candidate is advised to carry this Photo ID Card while appearing for Examination/ Personality Test.

2.2 The Commission has introduced the facility of withdrawal of Application for those candidates who do not want to appear for the Examination. In this regard, Instructions are mentioned in Appendix-II (B) of this Examination Notice.

3. LAST DATE OF SUBMISSION OF APPLICATIONS:

(I) The Online Applications can be filled up to **16th April, 2019 till 18.00 Hours**.

(II) The online Applications can be withdrawn from 23.04.2019 to 30.04.2019 till 6.00 PM. Detailed instructions regarding withdrawal of Applications is available at Appendix-II (B).

4. The eligible candidates shall be issued an e-Admission Certificate two weeks before the commencement of the examination. The e-Admission Certificate will be made available in the UPSC website [http://www.upsconline.nic.in] for downloading by candidates. No Admission Certificate will be sent by post. All the applicants are required to provide valid active E-Mail I.D. while filling up Online Application Form as the Commission may use electronic mode for contacting them at different stages of examination process.

5. SPECIAL INSTRUCTIONS :

Candidates are advised to read carefully "Special Instructions to the Candidates for Conventional Type Tests" (Appendix III).

6. FACILITATION COUNTER FOR GUIDANCE OF CANDIDATES :

In case of any guidance/information/clarification regarding their applications, candidature etc. candidates can contact UPSC's Facilitation Counter near 'C' Gate of its campus in person or over Telephone No. 011-23385271/011-23381125/01123098543 on working days between 10.00 hrs and 17.00 hrs.

Mobile Phones Banned:

(a)The use of any mobile phone (even in switched off mode), pager or any electronic equipment or programmable device or storage media like pen drive, smart watches etc. or camera or blue tooth devices or any other equipment or related accessories either in working or switched off mode capable of being used as a communication device during the examination is strictly prohibited. Any infringement of these instructions shall entail disciplinary action including ban from future examinations.

(b) Candidates are advised in their own interest not to bring any of the banned item including mobile phones or any valuable/costly items to the venue of the examination, as arrangement for safe-keeping cannot be assured. Commission will not be responsible for any loss in this regard.

No.4/1/2018 E.(lB) : A competitive examination for recruitment to the posts mentioned in para 2 below will be held by the Union Public Service Commission commencing from the **28th June,2019** in accordance with the Rules published by the Ministry of Mines in the Gazette of India dated the **20th March, 2019** at the following centres.

(1) AHMEDABAD (2) BANGALURU (3) BHOPAL (4) CHANDIGARH (5) CHENNAI (6) CUTTACK (7) DELHI (8) DISPUR (9) HYDERABAD (10) JAIPUR (11) JAMMU (12) KOLKATA (13) LUCKNOW (14) MUMBAI (15) PATNA (16) PRAYAGRAJ (ALLAHABAD) (17) SHILLONG (18) SHIMLA (19) THIRUVANANTHAPURAM

The centres and the dates of holding the examination as mentioned above are liable to be changed at the discretion of the Commission. Applicants should note that there will be a ceiling on the number of candidates allotted to each of the Centre, except Chennai, Delhi, Dispur, Kolkata and Ahmedabad. Allotment of Centres will be on the **"first-apply-first-allot"** basis, and once the capacity of a particular Centre is attained, the same will be frozen. Applicants, who cannot get a Centre of their choice due to ceiling, will be required to choose a Centre from the remaining ones. Applicants are, thus, advised that they may apply early so that they could get a Centre of their choice.

NB: notwithstanding the aforesaid provision, Commission reserves the right to change the Centres at their discretion if the situation demands. Candidates admitted to the examination will be informed of the time table and place or places of examination. Candidates should note that no request for change of centre will be granted. **All the examination centres for the examination will cater to the examination for Persons with Benchmark Disabilities also.**

2(a). The categories of post to which recruitment is to be made on the results of this examination and the approximate number of vacancies in the various posts are given below:-

Category I : (Posts in the Geological Survey of India, Ministry of Mines).

(i) Geologist, Group A : 50
(ii) Geophysicist, Group A : 14
(iii) Chemist. Group A : 15

Category II: (Posts in the Central Ground Water Board, Ministry of Water Resources)

(i) Junior Hydrogeologists (Scientist B), Group A : **27**

NOTE : Following vacancies are reserved for Persons with Benchmark Disability

02 vacancies of Geologist (01 for Hearing Impairement (HH) and 01 for Locomotor disability or Cerebral Palsy { [OA/OL]})

03 vacancies of Geophysicist (01 for Deaf and Hard of Hearing (HH) and 02 for Locomotor disability or Cerebral Palsy {1 [OA] and 1 [OL]})

01 Vacancy of Chemist (1 for Deaf and Hard of Hearing

03 Vacancies of Junior Hydrogeologists (Scientist B) Group A (01 for Blind or Low Vision, and 01 for Locomotor disability including Cerebral Palsy, Leprosy cured, dwarfism, acid attack victims and muscular dystrophy and 01 for autism, intellectual disability, specific learning disability and mental illness, multiple disabilities from amongst persons under clause (a) to (d) of Section 34 of RPwD Act, 2016 including deaf-blindness),

The above numbers of vacancies are liable to alteration.

Appointments will be made on a temporary basis in the first instance.

Reservations will be made for candidates belonging to Scheduled Castes, Scheduled Tribes, Other Backward Classes, Economically Weaker Sections and persons with benchmark disability categories in respect of vacancies as may be fixed by the Government.

A candidate will be eligible to get the benefit of community reservation only in case the particular caste to which the candidates belong is included in the list of reserved communities issued by the Central Government. The candidates will be eligible to get the benefit of the Economically Weaker

Section reservation only in case the candidate meets the criteria issued by the Central Government and in possession of such eligibility certification. If a candidate indicates in his/her application form for Combined Geo-Scientist and Geologist Examination that he/she belongs to General category but subsequently writes to the Commission to change his/her category to a reserved one, such request shall not be entertained by the Commission. Further, once a candidate has chosen a reserved category, no request shall be entertained for change to other reserved category viz. SC to ST, ST to SC, OBC to SC/ST or SC/ST to OBC, SC to EWS, EWS to SC, ST to EWS, EWS to ST, OBC to EWS, EWS to OBC. No reserved category candidates other than those recommended on General Merit shall be allowed to change his/her category from Reserved to Unreserved or claim the vacancies for UR category after the declaration of final result by UPSC.

Further no Person with Benchmark Disabilities (PwBD) of any subcategory thereunder shall be allowed to change his/her sub-category of disability.

While the above principle will be followed in general, there may be a few cases where there was a gap not more than 3 months between the issuance of a Government Notification enlisting a particular community in the list of any of the reserved communities and the date of submission of the application by the candidate. In such cases the request of change of community from general to reserved may be considered by the Commission on merit. In case of a candidate unfortunately becoming person with benchmark disability during the course of the examination process, the candidate should produce valid documents showing him/her acquiring a disability to the extent of 40% or more as defined under the Rights of Persons with Disabilities Act, 2016 to enable him/her to get the benefits of reservation earmarked for persons with benchmark disability provided he/she otherwise remains eligible for Geologist, Group A, Geophysicist, Group A, Chemist. Group A and Junior Hydrogeologist posts as per Rule 21 of the Rules of the Combined Geo-scientist and Geologist Examination, 2019.

Candidates seeking reservation/relaxation benefits available for SC/ST/OBC/EWSs/PwBD/Ex-servicemen must ensure that they are entitled to such reservation/relaxation as per eligibility prescribed in the Rules/Notice. They should also be in possession of all the requisite certificates in the prescribed format in support of their claim as stipulated in the Rules/ Notice for such benefits, and these certificates should be dated earlier than the due date (closing date) of the application.

Provided further that EWS Candidates can submit their Income and Asset Certificate (certificate of eligibility) at the time of submission of online Detailed Application Form (DAF). The Income and Asset Certificate must be dated earlier than 1st August, 2019. Since reservation for EWS category candidates has been notified recently, therefore this extension for submission of certificate for EWS category candidates is a one time relaxation applicable for Combined Geo-Scientist and Geologist Examination, 2019 only.

As per the decision taken by the Government for increasing the access of unemployed to job opportunities, the Commission will publically disclose the scores of the candidates (obtained in the Written Examination and Interview/Personality Test) through the public portals. The disclosure will be made in respect of only those candidates who will appear in the Interview/Personality Test for the Combined Geo-scientist and Geologist Examination and are not finally recommended for appointment. The information shared through this disclosure scheme about the non-recommended candidates may be used by other public and private recruitment agencies to appoint suitable candidates from the information made available in the public portal.

Candidates will be required to give their options at the time of Interview/ Personality Test, while acknowledging the e-summon letter mailed to them for interview. A candidate may opt out of the scheme also and in that case his/her details will not be published by the Commission.

Besides sharing of the information of the non-recommended candidates for the examinations conducted by the Commission, the Commission will not assume any responsibility or liability for the method and manner in which information related to candidates who appear at the Commission's Examinations/Selections is utilized by other private of public organizations.

2(b). A candidate may apply for admission to the examination in respect of any one or both the categories, mentioned in Para 2(a) above. Once an application has been made, no change will be allowed.

If a candidate wishes to be admitted for both the categories, he/she need fill in only one application. He/She will be required to pay the fee mentioned in para 4 below once only and will not be required to pay separate fee for each of the categories for which he/she applies.

A candidate may compete for any one or both the categories of Posts for which he/ she is eligible in terms of Rules. A candidate who qualifies for both the categories of Posts on the result of written part of

examination will be required to indicate clearly in the Detailed Application Form the categories of Posts for which he/ she wishes to be considered in the order of preference .

N.B: (i) : No request for making subsequent addition/alteration in the details indicated by a candidate in his Detailed Application Form will be entertained by the Commission.

N.B: (ii) : The selection of candidates for the posts of Geologist, Geophysicist and Chemist in GSI in the Ministry of Mines and Jr. Hydrogeologists (Scientist B), Group A, CGWB in the Ministry of Water Resources shall be strictly in accordance with their merit position in each category and number of vacancies separately.

N.B.(iii): In case of common candidates of Geologist and Jr. Hydrogeologist, they will be recommended by the Commission for one post only based on the preferences given by them in the Detailed Application Forms, order of merit and number of vacancies.

3. ELIGIBILITY CONDITIONS :

(I) Nationality

A candidate must be either:

(a) a Citizen of India, or

(b) a subject of Nepal, or

(c) a subject of Bhutan, or

(d) a Tibetan refugee who came over to India before the 1st January, 1962 with the intention of permanently settling in India. or

(e) a person of Indian origin who has migrated from Pakistan, Burma, Sri Lanka or East African Countries of Kenya, Uganda, the United Republic of Tanzania, Zambia, Malawi, Zaire and Ethiopia or from Vietnam with the intention of permanently settling in India.

Provided that a candidate belonging to categories (b), (c), (d) and (e) above shall be a person in whose favour a certificate of eligibility has been issued by the Government of India.

A candidate in whose case a certificate of eligibility is necessary, may be admitted to the examination but the offer of appointment may be given only after the necessary eligibility certificate has been issued to him/her by the Government of India.

(II) Age Limits: A candidate for this examination must have attained the age criteria as prescribed below:-

(a) For Geologist and Geophysicist and Chemist (Group 'A') in the Geological Survey of India, an attached office of Ministry of Mines, Government of India: A candidate must have attained the age of 21 years and must not have attained the age of 32 years on the first day of the month of January of the year in which the Examination is to be held [i.e. as on 1st January, 2019] i.e. he/she must have been born not earlier than 2nd January, 1987 and not later than 1st January 1998.

(b) **For Jr. Hydrogeologist (Scientist B) (Group A) in Central Ground water Board, Ministry of Water Resources:-**

Must have attained the age of 21 years and must not have attained at the age of 35 years on 1st January 2019 i.e. he/she must have been born not later than **2nd January 1984 and not later than 1st January 1998.**

NB: **Candidates should ensure that they meet the age eligibility criteria for each post mentioned above** for **which they are applying.**

(C) The upper age limit will be relaxable upto a maximum of 7 years in the case of Government servants, if they are employed in a Department mentioned in Column I below and apply for the corresponding post mentioned in column II.

Column I Column I

Geological Survey of India	(i) Geologist Group 'A' (ii) Geophysicist Group 'A' (iii) Chemist Group 'A'
Central Ground Water Board	(i) Jr. Hydrogeologist, (Scientist B) Gr. A

d) The upper age limit prescribed above will be further relaxable as follows:

(i) Upto a maximum of five years if a candidate belongs to a Scheduled Caste or a Scheduled Tribe.

(ii) Upto a maximum of three years in the case of candidate belonging to Other Backward Classes who are eligible to avail of reservation applicable to such candidates.

(iii) Upto a maximum of five years if a candidate had ordinarily been domiciled in the State of Jammu & Kashmir during the period from the 1st January, 1980 to the 31st day of December, 1989.

(iv) Upto a maximum of three years in the case of Defence Services Personnel disabled in operations during hostilities with any foreign country or in a disturbed area and released as a consequence thereof:

(v) Upto a maximum of five years in the case of Ex-Servicemen including Commissioned Officers and ECOs/SSCOs who have rendered at least five years Military Service as on 1st January, 2019 and have been released (i) on completion of assignment (including those whose assignment is due to be completed within one year from 1st January, 2019) otherwise than by way of dismissal or discharge on account of misconduct or inefficiency, or (ii) on account of physical disability attributable to Military Service or (iii) on invalidment.

(vi) Upto a maximum of 5 years in the case of ECOs/SSCOs who have completed an initial period of assignment of 5 years Military Service as on 1st January, 2019 and whose assignment has been extended beyond 5 years and in whose case the Ministry of Defence issue a certificate that they can apply for civil employment and that they will be released on 3 month's notice on selection from the date of receipt of offer of appointment.

(vii) Upto a maximum of 10 years in the case of blind, deaf-mute and orthopedically handicapped persons. up to a maximum of 10 years in the case of (a) blindness and low vision; (b) deaf and hard of hearing; (c) locomotor disability including cerebral palsy, leprosy cured, dwarfism, acid attack victims and muscular dystrophy; (d) autism, intellectual disability, specific learning disability and mental illness; and (e) multiple disabilities from amongst persons under clauses (a) to (d) including deaf-blindness.

Note I:—Candidates belonging to the Scheduled Castes and the Scheduled Tribes and the Other Backward Classes who are also covered under any other clauses of Para 3(II)(d) above, viz. those coming under the category of Ex-servicemen, persons domiciled in the State of J&K and (a) blindness and low vision; (b) deaf and hard of hearing; (c) locomotor disability including cerebral palsy, leprosy cured, dwarfism, acid attack victims and muscular dystrophy; (d) autism, intellectual disability, specific learning disability and mental illness; and (e) multiple disabilities from amongst persons under clauses (a) to (d) including deaf-blindness etc. will be eligible for grant of cumulative age-relaxation under both the categories.

NOTE II- The term Ex-Servicemen will apply to the persons who are defined as Ex-Servicemen in the Ex-servicemen (Re-employment in Civil Service and Posts) Rules, 1979, as amended from time to time.

NOTE Ill- The age concession under Para 3(II)(d)(v) and (vi) will be admissible to Ex-servicemen i.e. a person who has served in any rank whether as combatant or non-combatant in the Regular Army, Navy and Air Force of the Indian Union and who either has been retired or relieved or discharged from such service whether at his own request or being relieved by the employer after earning his or her pension.

NOTE IV- Notwithstanding the provision of age-relaxation under para 3(II)(d)(vii) above, a person with benchmark disability will be considered to be eligible for appointment only if he/she (after such physical examination as the Government or appointing authority, as the case may be, may prescribe) is found to satisfy the requirements of physical and medical standards for the concerned Services/ posts to be allocated to the persons with benchmark disabilities candidates by the Government.

Note V :— The details of Functional Classification (FC) and Physical Requirements (PR) of each service is indicated in this Notice which are identified and prescribed by the respective Cadre Controlling Authorities (CCAs) as per the provisions of Section 33 and 34 of the Rights of Persons with Disabilities Act, 2016. Only those category (ies) of disability (ies) mentioned in the Notice shall apply for the examination under Persons with Benchmark Disability (PwBD) categories. Therefore, the candidates belonging to the Persons with Benchmark Disability categories are advised to read it carefully before applying for the examination.

Save as provided above the age limits prescribed can in no case be relaxed. The date of birth accepted by the Commission is that entered in the Matriculation or Secondary School Leaving Certificate or in **a** certificate recognised by an Indian University as equivalent to Matriculation or in an extract from a Register of Matriculates maintained by a University which must be certified by the proper authority of the University or in the Higher Secondary or an equivalent examination certificate. These certificates are required to be submitted only after the declaration of the result of the written part of the examination.

No other document relating to age like horoscopes, affidavits, birth extracts from Municipal Corporation, service records and the like will be accepted. The expression Matriculation/Higher Secondary Examination Certificate in this part of the instruction includes the alternative certificate mentioned above.

NOTE I:- Candidates should note that only the Date of Birth as recorded in the Matriculation/Higher Secondary Examination Certificate or an equivalent certificate as on the date of submission of applications will be accepted by the Commission and no subsequent request for its change will be considered or granted.

NOTE II:- Candidates should also note that once a Date of Birth has been claimed by them and entered in the records of the Commission for the purpose of admission to an Examination**,** no change will be allowed subsequently (or at any other Examination of the Commission) on any ground whatsoever.

NOTE III :-The candidates should exercise due care while entering their date of birth in online application form for the Examination. If on verification at any subsequent stage, any variation is found in their date of birth from the one entered in their matriculation or equivalent Examination certificate, disciplinary action will be taken against them by the Commission under the Rules.

N.B. **-** (i) The candidature of a person who is admitted to the examination under the age concession mentioned in para 3(II)(c) above, shall be cancelled, if after submitting his/her application, he/she resigns from service or his/her services are terminated by his/her department/ office, either before or after taking the examination. He/she will, however, continue to be eligible if he/she is retrenched from the service or post after submitting the application.

(ii) A candidate who, after submitting his/ her application to his/her department is transferred to other department/office will be eligible to compete under departmental age concession for the post(s), for which he/she would have been eligible, but for his/her transfer, provided his/her application, duly recommended, has been forwarded by his/her parent Department.

(iii) Minimum Educational Qualification

(i) For Geologists Gr 'A' in Geological Survey of India

(a) Master's degree in Geological Science or Geology or Applied Geology or Geo-Exploration or Mineral Exploration or Engineering Geology or Marine Geology or Earth Science and Resource Management or Oceanography and Coastal Areas Studies or Petroleum Geosciences or Petroleum Exploration or Geochemistry or Geological Technology or Geophysical Technology from a University incorporated by an Act of the Central or State Legislature in India or an educational institution established by an Act of Parliament or declared to be deemed university under section 3 of the University Grants Commission Act, 1956 (3 of 1956)

(b) For Geophysicists Gr 'A' in Geological Survey of India

M.Sc. in Physics or Applied Physics or M.Sc. (Geophysics) or Integrated M.Sc. (Exploration Geophysics) or M.Sc (Applied Geophysics) or M.Sc. (Marine Geophysics) Or M.Sc. (Tech.) (Applied Geophysics) from a University incorporated by an Act of Parliament or State Legislature in India or other educational institutes established by an Act of the Parliament or declared to be deemed universities under the University Grants Commission Act, 1956.

(c) For Chemists Gr 'A' in Geological Survey of India

M. Sc. in Chemistry or Applied Chemistry or Analytical Chemistry from a University incorporated by an Act of Parliament or State Legislature or other educational Institutes established by an Act of the Parliament or declared to be deemed Universities under section 3 of the University Grants Commission Act, 1956 i.e. recognized University.

Note I: Master's degree in respective discipline means the post graduate degree or post graduate diploma of minimum two years duration after graduation from aforesaid University or Institute in the respective discipline, whether be it an integrated course or otherwise.

Note II :Candidates who have appeared at the final examinations of the minimum educational qualification specified in clause (a)to (c)of this paragraph, passing of which shall render them eligible to appear at the relevant year Examination, but have not been informed of the result, may also apply for admission to the Examination and in such case his or her admission to the relevant year Examination shall be provisional and subject to obtaining minimum educational qualification specified in clause (a) to (c) of this paragraph.

Note III : A candidate who is otherwise qualified but who possesses the Master's degree specified in clause (a) to (c) of this paragraph from a foreign University approved by the Government may also be admitted to the Examination by the Commission.

(ii) (a) **For Junior Hydrgeologists (Scientist B), Group 'A' in Central Ground Water Board.**

(a) Master's degree in Geology or Applied Geology or Marine Geology from a University incorporated by an Act of the Central or State Legislature in India or other educational Institutes established by an act of Parliament or declared to be deemed as Universities under Section 3 of the University Grants Commission Act, 1956; or

(b) Master's degree in Hydrogeology from a recognized University.

Note : Candidate possessing common qualifications in (i) (a) & (ii) (a) can apply for both the categories.

NOTE I- A candidate who has appeared at an examination, the passing of which would render him/her educationally qualified for this examination but has not been informed of the result, may apply for admission to the examination. A candidate who intends to appear at such a qualifying examination may also apply. Such candidates will be admitted to the examination, if otherwise eligible but their admission would be deemed to be provisional and subject to cancellation if they do not produce proof of having passed the requisite qualifying examination along with the detailed application form which will be required to be submitted by the candidates who qualify on the result of the written part of the examination. Such proof of passing the requisite examination should be dated earlier than the due date (closing date) of Detailed Application Form of the Combined Geo-Scientist and Geologist Examination, 2019.

NOTE II- In exceptional cases the Commission may treat a candidate who does not possess any of the qualifications prescribed in this rule, as educationally qualified provided that he/she has passed examinations conducted by other institutions, the standard of which in the opinion of the Commission, justifies his/ her admission to the examination.

NOTE III- A candidate who is otherwise eligible but who has taken a degree from a Foreign University recognized by Government may also apply to the Commission and may be admitted to the examination.

(IV) PHYSICAL STANDARDS:

Candidates must be physically fit according to physical standards for admission to the Examination, 2019 as per Regulations given in **Appendix-II** of the rules for the Combined Geo-scientist and Geologist Examination, 2019 in Gazette of India dated 20th March, 2019.

4. FEE:

Candidates (excepting Female/SC/ST/Persons with Benchmark Disability Candidates who are exempted from payment of fee) are required to pay fee of Rs. 200/- (Rupees Two Hundred only) either by remitting the money in any Branch of State Bank of India or by using Visa/Master/RuPay Credit/Debit Card or by using Internet Banking of SBI. Applicants who opt for "Pay by Cash" mode should print the system generated Pay-in-slip during part II registration and deposit the fee at the counter of SBI Branch on the next working day only. "Pay by Cash" mode will be deactivated at 23.59 hours of 15.04.2019 i.e. one day before the closing date; however applicants who have generated their Pay-in- Slip before it is deactivated may pay at the counter of SBI Branch during banking hours on the closing date. Such applicants who are unable to pay by cash on the closing date i.e during banking hours at SBI Branch, for reasons whatsoever, even if holding valid pay-in-slip will have no other offline option but to opt

for available online Debit/Credit Card or Internet Banking payment mode on the closing date i.e. till 18:00 Hours of 16.04.2019.

Note:2.. Candidates should note that payment of examination fee can be made only through the modes prescribed above. Payment of fee through any other mode is neither valid nor acceptable. Applications submitted without the prescribed fee/mode (unless remission of fee is claimed) shall be summarily rejected.
Note:3. Fee once paid shall not be refunded under any circumstances nor can the fee be held in reserve for any other examination or selection.
Note:4.. For the applicants in whose case payments details have not been received from the bank, they will be treated as fictitious payment cases and their applications will be rejected in the first instance. A list of all such applicants shall be made available on the Commission website within two weeks after the last day of submission of online application. The applicants shall be required to submit the proof of their fee payment within 10 days from the date of such communication either by hand or by speed post to the Commission. On receipt of documentary proof, genuine fee payment cases will be considered and their applications will be revived, if they are otherwise eligible.
All Female Candidates and candidates belonging to Scheduled Castes/ Scheduled Tribes are not required to pay any fee. No fee exemption is, however, available to OBC/ EWSs candidates and they are required to pay the prescribed full fee.
Persons with benchmark disability are exempted from the payment of fee provided they are otherwise eligible for appointment to the Posts to be filled on the results of this examination on the basis of the standards of medical fitness for these Posts (including any concessions specifically extended to the persons with benchmark disability). A person with benchmark disability claiming age relaxation/fee concession will be required by the Commission to submit along with their detailed application form, a certified copy of the certificate of disability from a Government Hospital/Medical Board in support of his/her claim for being person with benchmark disability.
NOTE: Notwithstanding the aforesaid provision for age relaxation/fee exemption, a person with benchmark disability candidate will be considered to be eligible for appointment only if he/she (after such physical examination as the Government or the appointing authority, as the case may be, may prescribe) is found to satisfy the requirements of physical and medical standards for the concerned Services/Posts to be allocated to Persons with benchmark disability candidates by the Government.
Note : Applications without the prescribed Fee (Unless remission of Fee is claimed) shall be summarily rejected.

5. How to Apply:

(a) Candidates are required to apply Online using the link https://www.upsconline.nic.in Detailed instructions for filling up Online Applications are available on the above mentioned website.

(b) The applicants are advised to submit only single application. However, if due to any unavoidable situation, he/she submits another/multiple applications, then he/she must ensure that application with the higher RID is complete in all respects like applicants details, examination centre, photograph, Photo I.D., signature, fee etc. The applicants who are submitting multiple applications should note that only the applications with higher RID (Registration ID) shall be entertained by the Commission and fee paid against one RID shall not be adjusted against any other RID.

(c) All candidates, whether already in Government Service, in Government owned industrial undertakings or other similar organisations or in private employment should submit their applications direct to the Commission. Persons already in Government service, whether in permanent or temporary capacity or as work charged employees other than casual or daily rated employees or those serving under the Public Enterprises are, however, required to inform in writing their Head of Office/ Department that they have applied for the Examination. Candidates should note that in case a communication is received from their employer by the Commission withholding permission to the candidates applying for/appearing at the examination, their application will be liable to be rejected/candidature will be liable to be cancelled.

NOTE 1: While filling in his online application form, the candidates should carefully decide about his/her choice for the centre for the examination.
If any candidate appears at a centre other than the one indicated by the Commission in the e-Admission Certificate, the papers of such a candidate will not be valued and his/her candidature will be liable to cancellation.
NOTE 2 : Incomplete or defective applications shall be summarily rejected. No representation or correspondence regarding such rejection shall be entertained under any circumstances.

(d) Candidates are not required to submit hard copy of their application to the commission at this stage. **The candidates applying for the examination should ensure that they fulfill all the eligibility conditions for admission to the Examination. Their admission at all the stages of examination for which they are admitted by the Commission viz. Written Examination and Interview Test will be purely provisional, subject to their satisfying the prescribed eligibility conditions. If on verification at any time before or after the written Examination or Interview Test, it is found that they do not fulfill any of the eligibility conditions, their candidature for the examination will be cancelled by the Commission.**

Candidates are requested to keep ready the attested copies of the following documents for submission to the Commission soon after the declaration of the result of the written part of the examination which is likely to be declared in the month of **August, 2019.**

1. Certificate of Age.
2. Certificate of Educational Qualification.
3. Certificate in support of claim to belong to Scheduled Caste, Scheduled Tribe, Economically Weaker Sections and Other Backward Classes where applicable.
4. Certificate in support of claim for age/ fee concession, wherever applicable.
5. Certificate in support of being persons with benchmark disability (wherever applicable).

Immediately after the declaration of the result of the written part of the examination successful candidates will be intimated by the Commission electronically and they shall be asked to submit Detailed Application Form (DAF) online. The successful candidates have to send the printout of this DAF with each page duly signed along with the attested copies of the above mentioned certificates to the Commission at that time. Originals will have to be produced at the time of interview. The interview letter to the candidates may also be issued electronically.

If any of their claims is found to be incorrect, they may render themselves liable to disciplinary action by the Commission in terms of Rule 14 of the Combined Geo-Scientist and Geologist Examination, 2019 notified in the Gazette of India dated **20th March,** 2019 and also reproduced below:

A candidate who is or has been declared by the Commission to be guilty of:

(i) obtaining support for his/her candidature by any following means namely;

(a) offering illegal gratification; or

(b) applying pressure on ; or

(c) blackmailing or threatening to blackmail any person connected with the conduct of the examination; or

(ii) impersonation, or

(iii) procuring impersonation by any person, or

(iv) submitting fabricated documents or documents which have been tampered with, or

(v) uploading irrelevant photos in the application form in place of actual photo/signature.

(vi) making statements which are incorrect or false or suppressing material information, or

(vii) resorting to any other irregular or improper means in connection with his/ her candidature for the examination, or

(viii) being in possession of or using unfair means during the examination, or

(ix) writing irrelevant matter, including obscene 'languages or pornographic matter, in the script(s), or

(x) misbehaving in any other manner in the examination hall, or

(xi) harassing or doing bodily harm to the Staff employed by the Commission for the conduct of their examination, or

(xii) being in possession of or using any mobile phone (even in switched off mode), pager or any electronic equipment or programmable device or storage media like pen drive, smart watches etc. or camera or blue tooth devices or any other equipment or related accessories either in working or switched off mode capable of being used as a communication device during the examination; or

(xiii) violating any of the instructions issued to candidates along with their e-Admission Certificates permitting them to take the examination, or

(xiv) Attempting to commit or as the case may be abetting the commission of all or any of the acts specified in the foregoing clauses, may in addition to rendering himself/herself liable to criminal prosecution is liable.

(a) to be disqualified by the Commission from the examination for which he/she is a candidate and/or

(b) to be debarred either permanently or for a specified period

(i) by the Commission from any examination or selection held by them;

(ii) by the Central Government from any employment under them; and

(c) if he/she is already in service under Government to disciplinary action under the appropriate rules.

Provided that no penalty under these rules shall be imposed except after.

(i) giving the candidate an opportunity of making such representation, in writing as he/she may wish to make in that behalf; and

(ii) taking the representation, if any, submitted by the candidate within the period allowed to him/her into consideration.

6. LAST DATE FOR SUBMISSION OF APPLICATIONS:

The Online Applications can be filled upto **16th April, 2019 ti11 18.00 Hours**.

7. CORRESPONDENCE WITH COMMISSION:

The Commission will not enter into any correspondence with the candidates about their candidature except in the following cases:

(i) The eligible candidates shall be issued an e-Admission Certificate three weeks before the commencement of the examination. The e-Admission Certificate will be made available on the UPSC Web-site [https://www.upsc.gov.in] for downloading by candidates. No Admission Certificate will be sent by post. For downloading the e-Admission Certificate/e-Admit Card the candidate must have his/her vital parameters like RID and Date of Birth or Roll No. (if received) & date of birth or name, father's name & Date of Birth available with him/her. **If a candidate does not receive his/her admission certificate or any other communication regarding his/her candidature for the examination three weeks before the commencement of the examination, he/she should at once contact the Commission.** Information in this regard can also be obtained from the Facilitation Counter located in the Commission's Office either in person or over phone Nos.011-23381125/011-23385271/011-23098543. **In case no communication is received in the Commission's office from the candidate regarding non-receipt of his/her e-Admission Certificate at least three weeks before the examination, he/she himself/herself will be solely responsible for non-receipt of his/her e-Admission Certificate.**

No candidate will ordinarily be allowed to take the examination unless he/she holds an e-admission certificate for the examination. On receipt of e-Admission Certificate, check it carefully and bring discrepancies/errors, if any, to the notice of UPSC immediately.

The candidates should note that their admission to the examination will be purely provisional based on the information given by them in the Application Form. This will be subject to verification of all the eligibility conditions by the UPSC.

The mere fact that an e-admission certificate to the Examination has been issued to a candidate will not imply that the Commission has finally cleared his/her candidature or that the Commission has accepted entries made by the candidate in his/her application for the Examination as true and correct. Candidates may note that the Commission will take up the verification of eligibility conditions of a candidate, with reference to original documents, only after the candidate has qualified the Combined Geo-Scientist and Geologist (Written) Examination. Unless the Commission formally confirms candidature, it continues to be provisional.

The decision of the Commission as to the eligibility or otherwise of a candidate for admission to the Examination shall be final.

Candidates should note that the name in the e-Admission Certificate in some cases may be abbreviated due to technical reasons.

(ii) The candidates must ensure that their E-Mail IDs given in their Online Applications are valid and active as the Commission may use electronic mode of communication while contacting them at different stages of examination processes.

(iii) A candidate must see that communications sent to him/her at the address stated in his/her application are redirected, if necessary. Change in address should be communicated to the Commission at the earliest opportunity. Although the Commission make every effort to take account of such changes, they cannot accept any responsibility in the matter.

(iv) Candidates may note that they will not be allowed to take the examination on the strength of an e-Admission Certificate issued in respect of another candidate.

Important: All communications to the Commission should invariably contain the following particulars.

1. Name and year of examination.
2. Registration I.D. (RID) Number
3. Roll No. (if received)
4. Name of candidate in full and in Block Letters.
5. Complete Postal Address as given in the Application.
6. Valid and active E-mail I.D.

N.B. : (i) Communications not containing the above particulars may not be attended to.
N.B. (ii) If a letter/communication is received from a candidate after an examination has been held and it does not give his/her full name and Roll number, it will be ignored and no action will be taken thereon.
N.B.: (iii) Candidates are strongly advised to keep a printout or soft copy of their online application for future references.

8. The eligibility for availing reservation against the vacancies reserved for the Persons with Benchmark Disabilities shall be the same as prescribed in "The Rights of Persons with Disabilities Act, 2016 (RPwD Act, 2016)". The candidates of Multiple Disabilities will be eligible for reservation under category (e) - Multiple Disabilities only of Section 34(1) of RPwD Act, 2016 and shall not be eligible for reservation under any other categories of disabilities i.e. (a) to (d) of Section 34(1) of RPwD Act, 2016 on account of having 40% and above impairment in any of these categories of PwBD.

Provided further that the persons with Benchmark Disabilities shall also be required to meet special eligibility criteria in terms of physical requirements/functional classification (abilities/ disabilities) consistent with requirements of the identified Service/Post as under:-

Geologist:

Sl.	Functional Classification	Physical Requirements
1	PD	S, ST, BN, MF, SE, W,KC, C
2	OA, OL	S, ST, BN, MF, SE, W, KC, C

Geophysicist

Sl.	Functional Classification	Physical Requirements
1	PD	S, ST, BN, MF, SE, W,KC, C
2	OA, OL	S, ST, BN, MF, SE, W, KC, C

Chemist

Sl.	Functional Classification	Physical Requirements
1	PD	S, ST, BN, MF, SE, W,KC, C

Hydrogeologist

Sl.	**Functional Classification**	**Physical Requirements**
a	Blindness (B)	H, SP, S, ST, W, MF, RW (in Braille/ software)
	Low Vision (LV)	H, SP, S, ST, W, MF, RW, SE (with appropriate aids)
b	Deaf (D)	SP, S, ST, W, MF, RW, SE
	Hard of Hearing (HH)	H (with appropriate aids), SP, S, ST, W, MF, RW, SE
c	OA (One Arm affected), OL (One leg affected), OLA (One arm and one leg affected), BL (Both leg affected) , DW (Dwarfism), LC (Leprosy Cured), AAV (Acid Attack Victims)	H, SP, S, ST, W, MF, RW, SE [Mobility should not be affected. Persons should be assessed with appropriate aids and appliances].
d	SLD (except dyscalculia)	H, SP, S, ST, W, MF, RW, SE, N

Sl.	Functional Classification	Physical Requirements
e	Multiple Disability (MD) involve the following:-	
	• Locomotor Disability (excluding muscular dystrophy) with low vision or blindness i.e. OA with LV/B, OL with LV/B, OLA with LV/B, BL with LV/B, DW with LV/B, AAV with LV/B, LC with LV/B.	H, SP, S, ST, W, MF, RW (for Blindness in Braille/software), SE (for LV only)
	• Locomotor Disability (excluding muscular dystrophy) with Deaf (D) or Hard of Hearing (HH) i.e. OA with D/HH, OL with D/HH, OLA with D/HH, BL with D/HH, DW with D/HH, AAV with D/HH, LC with D/HH.	SP, S, ST, W, MF, RW, SE, H (for HH only)
	• LV with HH	H (with appropriate aids), SP, S, ST, W, MF, RW, SE (with appropriate aids)
	• Locomotor disability (excluding muscular dystrophy) with SLD i.e. OA with SLD, OL with SLD, OAL with SLD, BL with SLD, AAV with SLD, DW with SLD	H, SP, S, ST, W, MF, RW, SE, N [Mobility should not be affected. Persons should be assessed with appropriate aids and appliances].
	• SLD with LV	H, SP, S, ST, W, MF, RW, SE (with appropriate aids), N
	• SLD with HH	H (with appropriate aids), SP, S, ST, W, MF, RW, SE, N
	• Locomotor Disability (excluding muscular dystrophy) with HH	H, SP, S, ST, W, MF, RW (for Blindness in Braille/software), SE (for LV only)

Note: H- Hearing, SP- Speaking, S – Sitting, ST – Standing, W – Walking, MF – Manipulation by fingers, RW – Reading & Writing, SE – Seeing, OA - One Arm affected, OL - One Leg affected, OLA - One Leg One Arm affected, N- Numerical calculation ability, and BL - Both legs affected.

9. Details about the scheme of examination, standard and syllabi of the subjects etc. may be seen in Appendix-I of this Notice.

(OM PRAKASH)
UNDER SECRETARY
UNION PUBLIC SERVICE COMMISSION

APPENDIX-I
SCHEME OF EXAMINATION

1. The examination shall be conducted according to the following Plan :

Part I. - Written examination in the subjects as set out in para 2 below.

Part II. - Interview/ Personality Test of such candidates as may be called by the Commission, carrying a maximum of 200 marks.

2. The following will be the subjects for the written examination, for selection to the post of Geologist, Geophysicist and Chemist Group 'A' in GSI and Junior Hydro-geologist (Scientist 'B'), Group 'A' for Central Ground Water Board.

Subject	Duration	Maximum Marks
(1)	(2)	(3)
1. General_English (common for all category)	3 hrs	100
Category - 1 For the post of Geologist		
2. Geology Paper I	3 hrs	200
3. Geology Paper II:	3 hrs	200
4. Geology Paper III:	3 hrs	200
Category - 2 For the post of Geophysicist		
2. Geophysics Paper I:	3 hrs	200
3. Geophysics Paper II:	3 hrs	200
4. Geophysics Paper III:	3 hrs	200
Category - 3 For the post of Chemist		
2. Chemistry Paper I:	3 hrs	200
3. Chemistry Paper II:	3 hrs	200
4. Chemistry Paper III:	3 hrs	200
Category - 4 For the Post of Jr. Hydrogeologist		
2. Geology Paper I	3 hrs	200
3. Geology Paper II	3 hrs	200
4. Hydrogeology	3 hrs	200

Note I: Candidates competing for selection to the posts of Geologist, Geophysicist, Chemist and Junior Hydrogeologist will be required to appear in all the subjects mentioned against respective category above.

Note II: Candidates competing for selection for both the posts of Geologist and Jr. Hydrogeologist will be required to appear in all the subjects mentioned against Categories **1** and 4 above.

Note III : If any candidate failed to appear in any one or more of above papers, meant for written examination for selection to the post of Geologist, Geophysicist, Chemist, their candidature shall stand rejected and part of written examination appeared by him/her shall not be evaluated and counted for any purpose.

3. THE EXAMINATION IN ALL THE SUBJECTS WILL BE OF CONVENTIONAL (ESSAY) TYPE.

4. All Question papers must be answered in English. The Question Papers will be set in English only.

5. The standard and syllabus of the examination will be as shown in the Schedule.

6.(i) Candidates must write the papers in their own hand. In no circumstances will they be allowed the help of a scribe to write the answers for them. The Persons with Benchmark Disabilities in the categories of blindness, locomotor disability (both arm affected – BA) and cerebral palsy will be provided the facility of scribe, if desired by the person. In case of other category of Persons with Benchmark Disabilities as defined under section 2(r) of the RPWD Act, 2016, the facility of scribe will be allowed to such candidates on production of a certificate to the effect that the person concerned has physical limitation to write, and scribe is essential to write examination on behalf, from the Chief Medical Officer/ Civil Surgeon/ Medical Superintendent of a Government Health Care institution as per proforma at Appendix –IV.

(ii) The candidates have discretion of opting for his/her own scribe or request the Commission for the same. The details of scribe i.e. whether own or the Commission's and the details of scribe in case candidates are bringing their own scribe, will be sought at the time of filling up the application form online as per proforma at Appendix - V.

(iii) The qualification of the Commission's scribe as well as own scribe will not be more than the minimum qualification criteria of the examination. However, the qualification of the scribe should always be matriculate or above.

(iv) The Persons with Benchmark Disabilities in the category of blindness, locomotor disability (both arm affected – BA) and cerebral palsy will be allowed Compensatory Time of twenty minutes per hour of the examination. In case of other categories of Persons with Benchmark Disabilities, this facility will be provided on production of a certificate to the effect that the person concerned has physical limitation to write from the Chief Medical Officer/ Civil Surgeon/ Medical Superintendent of a Government Health Care institution as per proforma at Appendix –IV.

Note (1) : The eligibility conditions of a scribe, his/her conduct inside the examination hall and the manner in which and extent to which he/she can help the PwBD candidate in writing the Civil Services Examination shall be governed by the instructions issued by the UPSC in this regard. Violation of all or any of the said instructions shall entail the cancellation of the candidature of the PwBD candidate in addition to any other action that the UPSC may take against the scribe.

Note (2) : The criteria for determining the percentage of visual impairment shall be as follows :—

Better eye **Best Corrected**	**Worse eye** **Best Corrected**	**Per Cent** **Impairment**	**Disability category**
6/6 to 6/18	6/6 to 6/18	0%	0
	6/24 to 6/60	10%	0
	Less than 6/60 to 3/60	20%	I
	Less than 3/60 to No Light Perception	30%	II (One eyed person)
6/24 to 6/60 Or Visual field less than 40 up to 20 degree around centre of fixation or heminaopia involving macula	6/24 to 6/60	40%	III a (low vision)
	Less than 6/60 to 3/60	50%	III b (low vision)
	Less than 3/60 to No Light Perception	60%	III c (low vision)
Less than 6/60 to 3/60 Or Visual field less than 20 up to 10 degree around centre of fixation	Less than 6/60 to 3/60	70%	III d (low vision)
	Less than 3/60 to No Light Perception	80%	III e (low vision)
Less than 3/60 to 1/60 Or Visual field less than 10 degree around centre of fixation	Less than 3/60 to No Light Perception	90%	IV a (Blindness)
Only HMCF Only Light Perception No Light Perception	Only HMCF Only Light Perception No Light Perception	100%	IV b (Blindness)

Note (3) : The concession admissible to blind/low vision candidates shall not be admissible to those suffering from Myopia.

7. The Commission have discretion to fix qualifying marks in any or all the subjects of the examination.
8. If a candidate's handwriting is not easily legible, deduction will be made on this account from the total marks otherwise accruing to him/her.
9. Marks will not be allotted for mere superficial knowledge.
10. Credit will be given for orderly, effective and exact expression combined with due economy of words in all subjects of the examination.

11. In the question papers wherever necessary, questions involving the Metric System of Weights and Measures only will be set.

12. Candidates should use only International form of Indian numerals (e.g. 1, 2, 3, 4, 5, 6 etc) while answering question papers.

13. Candidates are permitted to bring and use battery operated pocket calculators for answering papers in this examination. Loaning or inter-changing of calculators in the Examination Hall is not permitted.

Interview/Personality Test : The candidate will be interviewed by a Board of competent and unbiased observers who will have before them a record of his/ her career. The object of the interview is to assess his/her suitability for the posts

for which he/she has competed. Special attention will be paid in the Personality Test to assessing the candidate's capacity for leadership, initiative and intellectual curiosity, tact and other social qualities, mental and physical energy, powers of practical application, integrity of character and aptitude for adapting themselves to the field life.

SCHEDULE

STANDARD AND SYLLABUS

A paper in General English is compulsory and common for all the four categories and its standard will be such as may be expected of a science graduate. 3 compulsory papers each on Geology Geophysics, Chemistry and Hydrogeology subjects will be approximately of the M.Sc. degree standard of an Indian University and questions will generally be set to test the candidate's grasp of the fundamentals in each subject.

There will be no practical examination in any of the subjects.

GENERAL ENGLISH : 100 Marks

Candidate will be required to write a short Essay in English. Other questions will be designed to test their understanding of English and workmanlike use of words.

GEOLOGY - PAPER I : 200 Marks

Section A : Geomorphology and Remote Sensing.

Introduction : Development, Scope, Geomorphic concepts, Types and Tools; Landforms: Role of Lithology, peneplaination, endogenous and exogenous forces responsible, climatic and Tectonic factors and rejuvenation of landforms; Denudational processes : Weathering , erosion, transportation, weathering products and soils – profiles, types, duricrusts; Hillslopes : Their characteristics and development, fluvial processes on hillslopes; River and drainage basin: Drainage pattern, network characteristics, Valleys and their development, processes of river erosion, transportation and deposition; Landforms produced by geomorphic agents: Fluvial, Coastal , Glacial and Aeolian landforms; Geomorphic indicators of neotectonic movements : Stream channel morphology changes , drainage modifications, fault reactivation, Uplift – subsidence pattern in coastal areas; Applied Geomorphology : Application in various fields of earth sciences viz. Mineral prospecting, Geohydrology, Civil Engineering and Environmental studies; Geomorphology of India: Geomorphical features and zones

Electromagnetic radiation – characteristics, remote sensing regions and bands; General orbital and sensor characteristics of remote sensing satellites; Spectra of common natural objects – soil, rock, water and vegetation. Aerial photos – types, scale, resolution, properties of aerial photos, stereoscopic parallax, relief displacement; Principles of photogrammetry; Digital image processing - characteristics of remote sensing data, preprocessing, enhancements, classification; Elements of photo and imagery pattern and interpretation, application in Geology; Remote sensing applications in interpreting structure and tectonics, Lithological mapping, mineral resources, natural hazards and disaster mitigation, groundwater potentials and environmental monitoring. Landsat, Skylab, Seasat and other foreign systems of satellites and their interpretation for geological and other studies; Space research in India – Bhaskara and IRS systems and their applications, Thermal IR remote sensing and its applications, Microwave remote sensing and its applications. Principles and components of Geographic Information System (GIS), remote sensing data integration with GIS, applications of GIS in various geological studies.

Section B: Structural Geology

Principle of geological mapping and map reading, projection diagrams. Stress-strain relationships for elastic, plastic and viscous materials. Measurement of strain in deformed rocks. Behaviour of minerals and rocks under deformation conditions. Structural analysis of folds, cleavages, lineations, joints and faults. Superposed deformation. Mechanism of folding, faulting and progressive deformation. Shear

Zones: Brittle and ductile shear zones, geometry and products of shear zones; Mylonites and cataclasites, their origin and significance.Time relationship between crystallization and deformation. Unconformities and basement-cover relations. Structural behaviour of igneous plutons, diapirs and salt domes. Introduction to petrofabric analysis.

Section C: Geodynamics

Earth and its internal structure. Continental drift – geological and geophysical evidence and objections. An overview of plate tectonics including elementary concepts of plates, lithosphere, asthenosphere, types of plate boundaries and associated important geological features like oceanic trenches, volcanic arcs, accretionary wedges, topography of mid-ocean ridges, magnetic anomaly stripes and transform faults. Gravity anomalies at mid-ocean ridges, deep sea trenches, continental shield areas and mountain chains. Palaeomagnetism and its application for determining palaeoposition of continents. Isostasy, Orogeny and Epeirogeny. Seismic belts of the earth. Seismiciy at plate boundaries. Principles of Geodesy, Global Positioning System (GPS) and its application in crustal motion monitoring including neotectonics. Palaeoposition of India and Geodynamics of the Indian plate.

Section D: Stratigraphy

Principles of Statigraphy : History and Development of Statigraphy; Stratigraphic procedures (Surface and Subsurface); Concept of Lithofacies and Biofacies; Stratigraphic Correlation (Litho, Bio- and Chronostrarigraphic Correlation); Study of standard stratigraphic code (Lithostratigraphic, Biostratigraphic and Chronostratigraphic); Concepts of Magnetostratigraphy, Chemostratigraphy, Event stratigraphy, and Sequence stratigraphy; Nomenclature and the modern stratigraphic code. Radioisotopes and measuring geological time. Geological time-scale. Stratigraphic procedures of correlation of unfossiliferous rocks. Precambrian stratigraphy of India : Achaean stratigraphy -tectonic frame-work, geological history and evolution of Dharwar, and their equivalents; Easterghats mobile belt; Proterozoic stratigraphy -tectonic framework, geological history and evolution of Cuddapahs and their equivalents. Palaeozoic stratigraphy: Palaeozoic formations of India with special reference to type localities, history of sedimentation, fossil content. Mesozoic stratigraphy: Mesozoic formations of India with special reference to type localities, history of sedimentation, fossil content. Cenozoic stratigraphy: Cenozoic formations of India, Rise of the Himalayas and evolution of Siwalik basin. Stratigraphic boundaries: Stratigraphic boundary problems in Indian geology. Gondwana Supergroup and Gondwanaland. Deccan Volcanics. Quaternary stratigraphy. Rocks record, palaeoclimates and palaeogeography.

Section E : Palaeontology

Evolution of the fossil record and the geological time scale. Basic and functional morphology of major fossil groups. Species concept; Major evolutionary theories ; Techniques in Palaeontology mega fossils- microfossils – nannofossils , ichnofossils – collection, identification and illustration – binomial Nomenclature; Invertebrate Palaeontology – A brief study of morphology, classification, evolutionary trends and distribution of Bivalves, cephalopoda and Gastropods, Echinoids, Corals and Brachiopods. Vertebrate Palaeontology – Brief study of vertebrate life through ages. Evolution of reptiles and mammals; Siwalik vertebrate fauna; Biodiversity and mass extinction events; evidence of life in Precambrian times; Palaeontological perspective : Use of palaeontological data in a) Stratigraphy b) Palaeoecology and evolution; Introduction to Micropalaeontology; Types of Microfossils; Plant fossils: Gondwana flora and their significance. Different microfossil groups and their distribution in India; Application of palynology. Basic idea about statistical application in palaeontology. Fundamentals of isotopic studies of fossils.

GEOLOGY – PAPER II : 200 Marks

Section A : Mineralogy and Geochemistry & Isotope Geology

External symmetry of crystals: Symmetry Elements, methods of projection, derivation of 32 classes, Hermaun Muguin notation. Internal symmetry of crystals: Derivation of 230 space groups, diffraction of crystals by X-rays, Braggs' law. Principles of optical mineralogy : Optical mineralogy, polarized light, behaviour of isotropic and anisotropic minerals in polarized light, refractive index, double refraction, birefringence, sign of elongation, interference figures, 2V, dispersion in minerals. Optic sign, pleochroic scheme and determination of fast and slow vibrations and accessory plates. Introduction to mineralogy: Definition and classification of minerals. Structural and chemical principles of crystals / minerals, chemical bonds, ionic radii, coordination number (CN) and polyhedron. Structure, chemistry, physical and optical characters and paragenesis of mineral groups: Olivine, pyroxene, amphibole, mica and spinel groups; Feldspar, quartz, feldspathoid, aluminum silicate, epidote and garnet groups. Accessory minerals: Apatite, calcite,

corundum, scapolite, sphene and zircon. Earth mineralogy: Average mineralogical composition of crust and mantle, mineral transformations in the mantle with depth.

Earth in relation to the solar system and universe, cosmic abundance of elements. Composition of the planets and meteorites. Structure and composition of earth and distribution of elements. Trace elements and REE and their importance in fractional crystallization during magmatic / partial melting. Elementary crystal chemistry and thermodynamics. Introduction to isotope geochemistry. Geochronology and age of the Earth: Law of Radioactivity; Principles of isotopic dating, Decay schemes and Derivation of equation of age. Rb/Sr, U- Th –Pb methods of dating the rocks. Age of the Earth. Geochemistry and principles of evolution of hydrosphere, biosphere and atmosphere. Geochemical cycle and principles of geochemical prospecting.

Section B : Igneous Petrology

Origin of magmas: Mantle, onset of partial melting of mantle, processes of partial melting in mantle, mantle-magmas in relation to degree and depth-level of partial melting. Phase equilibrium in igneous systems: Binary and ternary systems. Bowen's reaction principle: Reaction series and its application to petrogenesis. Magmatic evolution and differentiation: Fractional crystallization, gravitational differentiation, gas streaming, liquid immiscibility and assimilation. Structures and textures: Definition, description, rock examples and genetic implications of common structures and textures of igneous rocks. Classification of igneous rocks: Mode, CIPW norm, IUGS and other standard classifications; Magmatism and tectonics: Inter-relationship between tectonic settings and igneous rock suites. Igneous rock suites: Form, structure, texture, modal mineralogy, petrogenesis and distribution of Ultramafic rocks: Dunite-peridotite-pyroxenite suite; kimberlites, lamprophyres, lamproites, komatiites; Basic rocks: Gabbro-norite-anorthosite-troctolite suite, Dolerites; Basalts and related rocks; Intermediate rocks: Diorite-monzonite-syenite suite; Andesites and related rocks; Acidic rocks: Granite-syenite-granodiorite-tonalite suite; Rhyolites and related rocks; Alkaline rocks: Shonkinite, ijolite, urtite, melteigite, malignite, alkali gabbros, alkali basalt, alkali granite, alkali syenite, nepheline syenite and phonolite; Carbonatites; Ophiolite suite.

Petrogenetic provinces : Continental areas: Volcanic-Flood basalts-Tholeiites (Deccan Trap, Columbia River basalts); Layered gabbroic intrusions: The Bushveld complex, Skaergaard intrusion, Still water complex. Plutonic: Carbonatites and alkaline rock complexes of India; Oceanic Rift valleys: MORB- Tholeiites-Ophiolites

Section C : Metamorphic Petrology & Processes

Concepts and Theory: Types of Metamorphism and their controlling factors; Common minerals of metamorphic rocks; Field observations, petrographic classification of common metamorphic rocks; Metamorphic facies and facies series. Effects of Metamorphism : Phase diagrams and graphic representation of mineral assemblages; Prograde and retrograde metamorphism, Matasomatism; Deformation textures and textures related to recrystallization; Metamorphic reactions, elemental exchange and Pressure – Temperature conditions of Isograds; Mineral assemblages equilibrium reaction textures and geo-thermo barometry. Experimental and thermodynamic appraisal of metamorphic reactions; Role of fluids in metamorphic reactions. Metamorphism types and products: Regional and thermal metamorphism of pelitic rocks. Regional and thermal metamorphism of basic and ultrabasic rocks; Regional and thermal metamorphism of impure, silicious carbonate rocks; Metamorphism of Granitoides, Charnockites and Migmatites. Metamorphism in space and time: Plate tectonics and metamorphic processes; Paired metamorphic belts, Archaean and Proterozoic terrains; Extraterrestrial Metamorphism (Impact and Shock Metamorphism); polymetamorphism

Section D : Sedimentology

(1) Provenance and diagenesis of sediments. Sedimentary textures. Framework, matrix and cement of terrigenous sediments. Definition, measurement and interpretation of grain size. Elements of hydraulics. Primary structures, palaeocurrent analysis. Biogenic and chemical sedimentary structures. Sedimentary environment and facies. Facies modeling for marine, non-marine and mixed sediments. Tectonics and sedimentation. Classification and definition of sedimentary basins. Sedimentary basins of India. Cyclic sediments. Seismic and sequence stratigraphy. Purpose and scope of basin analysis. Stratum contours and isopach maps.

Section E : Environmental Geology and Natural Hazards

Fundamental concepts of Environmental Geology - it's scope, objectives, and aims. Earth's thermal environment and Climates. Global warming. Green house effect. Ozone depletion–Ice sheets and fluctuation in sea levels. Concepts of ecosystem. Earth's major ecosystems terrestrial and aquatic.

Meteorology as environmental science. Air Pollution, sources of pollution, pollution due to dust and waste disposal. National and International standards. Environmental health hazards. Mining, opencast, underground, disposal of industrial and radio-active waste, dumping stacking, rehandling, management, mineral processing, tailing ponds, acid mine drainage, siltation, case studies. Mining below water table, mine water discharges, regional effects on water regime. Noise levels- national standards, mining machinery, ill effects. Air sampling techniques – respirable dust samplers, high volume air samplers, personal sampling pumps, weather monitoring equipments, automatic recorders. Elements of Environmental Impact Assessment – impacts, primary, secondary, prediction, assessment, base-line data generation, physical, biological, cultural, socioeconomic aspects. Carrying capacity based developmental planning – Assimilative capacity – supportive capacity – Resource based planning – Institutional strategies. Sustainable Developmental Planning - Applications of GIS in Environmental Management.Environmental Legislations in India.

Concepts and principles: Natural hazards – preventive/ precautionary measures – floods, landslides, earthquakes, river and coastal erosion. Distribution, magnitude and intensity of earthquakes. Neotectonics and seismic hazard assessment. preparation of seismic hazard maps. Impact of seismic hazards on long and short term environmental conditions. Mechanism of landslides, causes of major floods, cyclones and storms. Deforestation and land degradation. Coastal erosion, its causes and control of Geological hazards and crisis management.

GEOLOGY – PAPER III : 200 MARKS

Section A: Indian mineral deposits and mineral economics

Occurrence and distribution in India of metalliferous deposits - base metals, iron, manganese, aluminium, chromium, nickel, gold, silver, molybdenum. Indian deposits of non-metals – Diamond, mica, asbestos, barytes, gypsum, graphite, apatite and beryl. Gemstones, refractory minerals, abrasives and minerals used in glass, fertilizer, paint, ceramic and cement industries. Building stones. Phosphorite deposits. Placer deposits, rare earth minerals. Strategic, critical and essential minerals. India's status in mineral production vis a vis world scenario, Changing patterns of mineral consumption. UNFC classification, National Mineral Policy. Mineral Concession Rules. Marine mineral resources and Laws of Sea.

Section B: Ore genesis and Geophysics

Ore deposits and ore minerals. Magmatic processes of mineralization. Porphyry, skarn and hydrothermal mineralization. Fluid inclusion studies. Mineralisation associated with – (i) ultramafic, mafic and acidic rocks (ii) greenstone belts (iii) komatiites, anorthosites and kimberlites and (iv) submarine volcanism. Magma related mineralization through geological time. Stratiform and stratabound ores. Ores and metamorphism – cause and effect relations. Metallogeny and mineral belts.

Interrelationship between geology and geophysics - Role of geological and geophysical data in explaining geodynamical features of the earth. General and Exploration geophysics - Different types of geophysical methods; Gravity, magnetic, Electrical, Seismic - their principles and applications. Geophysical field operations - Different types of surveys, grid and route surveys, profiling and sounding techniques, scales of survey, presentation of geophysical data. Application of Geophysical methods - Regional geophysics, ore geophysics, engineering geophysics. Geophysical anomalies : correction to measured quantities, geophysical, anomaly, regional and residual (local) anomalies, factors controlling anomaly, depth of exploration. Integrated geophysical methods - Ambiguities in geophysical interpretation, Planning and execution of geophysical surveys.

Section C: Mineral exploration

Resource, reserve definitions; mineral resource in industries - historical perspective and present. A brief overview of classification of mineral deposits with respect to processes of formation in relation to exploration strategies. Principles of mineral prospecting and exploration - conceptualization, methodology and stages; sampling, subsurface sampling including pitting, trenching and drilling, core and non-core drilling, planning of bore holes and location of bore holes on ground. Core logging, geochemical exploration- nature of samples anomaly, strength of anomaly and controlling factors, coefficient of aqueous migration. Principles of reverse estimation, density and bulk density, factors affecting reliability of reserve estimation, reserve estimation based on geometrical models (square, rectangular, triangular and polygon blocks) regular and irregular grid patterns, statistics and error estimation. Application of Geophysical techniques, Geomorphological

and remote sensing techniques and Geobotanical and geochemical methods. Application of geostatistical techniques in Mineral Exploration.

Section D: Geology of fuels

Coal and its properties: Different varieties and ranks of coal. Origin of coal. Coalification process and its causes. Lithotypes, microlithotypes and macerals: their physical, chemical and optical properties. Maceral analysis of coal: Mineral and organic matter in coal. Petrographical methods and tools of examination. Fundamentals of coal petrology, concept of coal maturity, peat, lignite, bituminous and anthracite coal. Application of coal geology in hydrocarbon exploration. Applications of coal petrography. Proximate and ultimate analyses. Indian coal & lignite deposits. Industrial evaluation of coal characteristics with reference to coal classification. Geology and coal petrography of different coalfields of India. Uses of coal for various industries e.g. carbonization, liquefaction, power generation, gasification and coal-bed methane production.

Origin, migration and entrapment of natural hydrocarbons. Characters of source and reservoir rocks. Structural, stratigraphic and mixed traps. Techniques of exploration. Geographical and geological distributions of onshore and offshore petroliferous basins of India.

Mineralogy and geochemistry of radioactive minerals. Instrumental techniques of detection and measurement of radioactivity. Radioactive methods for prospecting and assaying of mineral deposits. Distribution of radioactive minerals in India. Radioactive methods in petroleum exploration – well logging techniques. Nuclear waste disposal – geological constraints.

Section E : Engineering Geology

Geological studies and evaluation in planning, design and construction of major civil structures. Elementary concepts of rock mechanics and soil mechanics. Site investigation, characterization and problems related to civil engineering projects: geological and geotechnical investigations for dams, reservoirs and spillways, tunnels, underground caverns, bridges, highways, shorelines. Problems of groundwater in engineering projects. Coastal geotechniques. Environmental considerations related to civil engineering projects. Resource evaluation of construction materials. Geological hazards (landslides and earthquakes), their significance, causes, preparedness and mitigation. Recent trends in geotechnical engineering. Geotechnical case studies of major projects in India.

GEOPHYSICS - PAPER I: 200 Marks

PART-A: 100 Marks

a. Solid Earth Geophysics:

Introduction to Geophysics its branches and relationship with other sciences. Solar system, its origin, characteristics of planetary members, Earth; its rotation and figure. Age of earth & various methods of determination. Tectonics and Geodynamics, Thermal history and its characteristics. Gravity field of earth and Isostasy. Geomagnetism, elements of earth's magnetism: Internal, External fields and their causes, Paleomagnetism, Polar wandering paths, Seafloor spreading, geophysical evidences. Elastic waves, internal structure of earth, variation of physical properties in the interior of earth.

b. Earthquake and Engineering Seismology:

Seismology, earthquakes, focal depth, epicenter, great Indian earthquakes, Intensity and Magnitude scales, Energy of earthquakes, foreshocks, aftershocks, Elastic rebound theory, Fault plane solutions, Seismicity and Seismotectonics of India, Frequency-Magnitude relation (b values), Velocity structure, VpNs studies. Elastic waves, their propagation characteristics. Seismic ray theory for spherically and horizontally stratified earth, basic principles of Seismic Tomography and receiver function analysis, Seismic network and arrays, telemetry systems, Earthquake prediction; dilatancy theory, short-term, middle-term and long- term predictions, Seismic microzonation studies, application for engineering problems, Seismometry, Principle of electromagnetic seismograph, displacement meters, velocity meter, accelerometer, WWSSN stations, Strong motion seismograph, seismic arrays for detection of nuclear explosions, Broadband seismometry.

c. **Mathematical methods in Geophysics**:

Properties of scalars, vectors and tensors, Elements of vector analysis, Gradient, Divergence and Curl, Gauss's divergence theorem, Stokes theorem, Definition of fields, Gravitational field, Newton's Law of gravitation, Gravitation potential and fields due to bodies of different geometric shapes, Electrostatic field, Coulomb's law, Electrical permittivity and dielectric constant, Basic guiding equations, Magneto static field, Origin of Magnetic field, Ampere's law, Biot and Savart's law, Geomagnetic fields, Magnetic fields due to different type of structures, Solution of Laplace equation in Cartesian Coordinate, Cylindrical Polar Coordinate and Spherical Polar Coordinate, Complex Variables in Potential theory, Green's theorem in Potential Theory.

Concept of Image in Potential Theory, Analytical continuation in Potential fields, Numerical Methods in Potential Theory. Electrical fields in geophysics, point source, continuous distribution and double layers, equipotential and line of force. Current and potential in the earth, basic concept and equations of electromagnetic, Maxwell's equations, boundary conditions, elliptic polarization, electromagnetic potential and waves, radiation from dipoles, retarded potential, near and far fields, radiation resistance, EM field of a loops of wire on half space, multi-layered media, impedance and its application.

d. Geophysical Inversion:

Fundamental concepts of inverse theory, Basic definition of inversions with application to Geophysics. Probability, Inverses with discrete and continuous models. Forward problems versus Inverse problems. Formulation of inverse problems and their relation to a matrix problem, linear inverse problems, classification of inverse problems, least square solutions and minimum norm solution, concept of norms, concept of 'a priori' information, constrained linear least square inversion, review of matrix theory Introduction to finite difference method, forward, backward and central difference mthod. Application of finite difference method for solving Helmholtz equation. Introduction to finite element method, various steps, simple examples showing application of finite element method. Models and data spaces, householder transformation, data resolution matrix, model resolution matrix, Eigen values and Eigen vectors, singular value decomposition (SVD), generalized inverses, Non-linear inverse problems, Gauss Newton method, steepest descent (gradient) method, Marquardt-Levenberg method, Earthquake location problem, tomography problem. Probabilistic approach of inverse problems, maximum likelihood and stochastic inverse methods, Backus-Gilbert method, Global optimization techniques, genetic algorithm, simulated annealing methods, examples of inverting geophysical data.

PART-B: 100 Marks

a. Mathematical Methods of Physics:

Dimensional analysis, Vector algebra and vector calculus, Linear algebra, matrices, Cayley-Hamilton Theorem. Eigen values and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Besse!, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem. Green's function. Partial differential equations (Laplace, wave and heat equations in two and three dimensions). Elements of computational techniques: root of functions, interpolation, and extrapolation, integration by trapezoid and Simpson's rule, solution of first order differential equation using Runge-Kutta method. Finite difference methods. Tensors. Introductory group theory: SU (2), 0 (3). Complex Variables, Beta, Gamma functions and special functions, Laplace Transform & Fourier series, Fourier Transforms, Introductory methods of Numerical analysis. Operators and their properties.

Thermodynamics and Statistical Physics:

Laws of thermodynamics and their consequences; Thermodynamic potentials, Maxwell relations; Chemical potential, phase equilibria; Phase space, micro- and macrostates; Micro canonical, canonical and grand-canonical ensembles and partition functions; Free Energy and connection with thermodynamic quantities; First-and second-order phase transitions; Classical and quantum statistics, ideal Fermi and Bose gases; Principle of detailed balance; Blackbody radiation and Planck's distribution law; Bose-Einstein condensation; Random walk and Brownian motion; Introduction to non equilibrium processes; Diffusion equation.

b. Electrodynamics:

Gauss Theorem, Poison's equation, Laplace's equation, solution to Laplace's equation in Cartesian coordinates, spherical, cylindrical coordinates, use of Laplace's equation in the solutions of electrostatic problems. Ampere's circuital law, magnetic vector potential, displacement current, Faraday's law of electromagnetic induction. Maxwell's equations, differential and integral forms, physical significance of Maxwell's equations. Wave equation, plane electromagnetic waves in free space, in non conducting isotropic medium, in conducting medium, electromagnetic vector an scalar potentials, uniqueness of electromagnetic potentials and concept of gauge, Lorentz gauge, Columb gauge, charged particles in electric and magnetic fields, charged particles in uniform electric field, charged particle in homogeneous magnetic fields, charged particles in simultaneous electric and magnetic fields, charged particles in non homogeneous magnetic fields. Lienard - Wiechert potentials, electromagnetic fields from Lienard - Wiechert potentials of a moving charge, electromagnetic fields of a uniformly moving charge, radiation due to non-relativistic charges, radiation damping, Abrahama-Lorentz formula, Cherenkov radiation, radiation due to oscillatory electric dipole, radiation due to small current element. Condition for plasma existence, occurrence of plasma, magneto hydrodynamics, plasma waves. Transformation of electromagnetic potentials, Lorentz condition in covariant form, invariance or covariance of Maxwell field equations in terms of 4 vectors, electromagnetic field tensor, Lorentz transformation of electric and magnetic fields.

c. Introductory Atmospheric and Space Physics:

The Neutral atmosphere, atmospheric nomenclature, the Hydrostatic equation, geopotential height, expansion and contraction, fundamental forces in the atmosphere, apparent forces, atmospheric composition, solar radiation interaction with the neutral atmosphere, climate change. Electromagnetic radiation and propagation of Waves: EM Radiation, fundamentals of EM waves, effects of environment, Antennas-basic considerations, types of antennas. Propagation of Waves: ground wave, sky wave, and space wave propagation, troposcatter communication and extra terrestrial communication. The Ionosphere, morphology of ionosphere, the D, E and F-regions, chemistry of the ionosphere, ionospheric parameters, E and F region anomalies and irregularities in the ionosphere. Global Positioning Systems (GPS)-basic concepts, overview of GPS system, augmentation services, GPS system segment, GPS signal characteristics, GPS errors, multi path effects, GPS performance, satellite navigation system and applications.

GEOPHYSICS - PAPER II : 200 Marks

PART-A: 100 Marks

a. Geophysical Potential Fields (Gravity and Magnetic)

Geophysical potential fields, Inverse square law of field, Principles of Gravity and Magnetic methods, Geoid, Spheroid, Nature of gravity and its variation, Properties of Newtonian potential, Laplace's and Poisons equations, Green's theorem, Gauss law, Concept of Bouguer gravity anomaly, Rock densities, factors controlling rock densities, determination of density, theory of isostasy, Earth's main magnetic field, origin, temporal variations, Geomagnetic elements, Columb's law of magnetic force and fields, intensity of magnetization and induction, magnetic potential and its relation to field, units of measurement, origin of magnetic anomalies, interrelationship between different components of anomalies, Poison's relation, Magnetic susceptibility, factors controlling susceptibility (Bulk chemistry, cooling history, metamorphism..), magnetic minerals, rock classification, Natural and remnant magnetism, Asiatic and Spinner magnetometers, demagnetization effects. Principles of Gravity and Magnetic instruments, Plan of conducting GM surveys, reduction of gravity and magnetic data, Airborne magnetic surveys and magnetic gradient surveys, Shipborne surveys, Gravity and Magnetic data reduction, IGSN Gravity bases, International Gravity formula, IGRF corrections for magnetic field. Separation of regional and residual anomalies, ambiguity in interpretation, Application of GM surveys for Geodynamic studies, Mineral Exploration, Environmental studies...Data processing and interpretation of anomalies, modeling of anomalies.

b. Electrical and Electromagnetic methods:

Electrical properties of rocks and their measurement, concepts and assumptions of horizontally stratified earth, anisotropy and its effects on electrical fields, the geo electric section and geological section, D.0 Resistivity method, fundamental laws, concept on natural electric field, electrode configuration, choice of methods, Profiling, Vertical Electrical Sounding.SP Method, Origin of SP, application of SP surveys, Origin of Induced Polarization, Membrane and Electrode potential, time and frequency domains of measurement, IP, chargeability, percent frequency effect and metal factor, dipole theory of IP, Application of IP surveys for mineral exploration (disseminated sulphides). Electromagnetic methods/ Telluric/Magneto Telluric methods, Passive and Active source methods, Maxwell's equations, electromagnetic potential and wave equations, boundary conditions, long wave length approximation, depth of penetration, amplitude and phase relations, real and imaginary components, Principles of EM prospecting, various EM methods, Dip angle method, Turam method, moving source-receiver methods-horizontal loop (Slingram) method, AFMAG, and VLF methods, Airborne EM systems - rotary field method, INPUT method, EM Profiling and sounding, Interpretation of EM anomalies, Principles of Ground Penetrating Radar (GPR), Origin and characteristics of MT fields, Instrumentation, Field methods and interpretation of MT data and applications.

c. Seismic Prospecting:

Basic principles of seismic methods, Fermat's principle, Senell's law, Reflection, refraction and diffraction from multilayered medium, Reflection and transmission coefficients, propagation model for exploration seismology, Seismic resolution, Seismic absorption and anisotropy, Seismic data acquisition, sources of energy, Geophones, geometry of arrays, Instrumentation, digital recording Seismic Surveys: Principle for multilayer refraction Travel time curves, corrections, Interpretation of data, Reflection principles, CDP, data processing, corrections, NMO correction, Interpretation of data, Fundamental of VSP method, Seismic Tomography. Principles of High Resolution Seismic (HRS) for coal exploration

d. Borehole Geophysics (Principles of Well logging):

Objectives of well logging, fundamental concepts in borehole geophysics, borehole conditions, properties of reservoir rock formations, formation parameters and their relationships-formation factor, porosity, permeability, formation water resistivity, water saturation, irreducible water saturation, hydrocarbon saturation, residual hydrocarbon saturation; Arhcie's and Humble's equations; principles, instrumentations, operational procedures and interpretations of various geophysical logs, SP log, resistivity and micro resistivity logs,

nuclear/radioactive logs, acoustic impedance and propagation logs, temperature log, caliper log and directional logs; production logging; clean sand and shaly sand interpretations; overlay and cross-plots of well-log data, determination of formation lithology, sub-surface correlation and mapping, delineation of fractures; application of well-logging in hydrocarbon, groundwater, coal, metallic and non-metallic mineral exploration.

PART-B: 100 Marks

a. Atomic and Molecular Physics and Properties and Characterization of materials:

Quantum states of an electron in an atom; Electron spin; Stern-Gerlach experiment; Spectrum of Hydrogen, helium and alkali atoms; Relativistic corrections for energy levels of hydrogen; Hyperfine structure and isotopic shift; width of spectral lines; LS & JJ coupling; Zeeman, Paschen Back & Stark effect; X-ray spectroscopy; Electron spin resonance, Nuclear magnetic resonance, chemical shift; Rotational, vibrational, electronic, and Raman spectra of diatomic molecules; Frank - Condon principle and selection rules; Spontaneous and stimulated emission, Einstein A & B coefficients; Lasers, optical pumping, population inversion, rate equation; Modes of resonators and coherence length. Thermal properties, optical properties, fundamentals of transmission electron microscopy, study of crystal structure using **TEM,** study of microstructure using SEM. Resonance methods- Spin and an applied field- the nature of spinning particles, interaction between spin and a magnetic field, population on energy levels, the Larmor precession, relaxation times - spin-spin relation, spin-lattice relaxation, Electron spin resonance- Introduction, g factor, experimental methods, Nuclear Magnetic resonance- equations of motion, line width motional narrowing, hyperfine splitting, Nuclear Gamma Resonance: Principles of Mossbauer Spectroscopy, Line width, Resonance absorption, Mossbauer Spectrometer, Isomer Shift, Quadrupole splitting, magnetic field effects, applications.

b. Nuclear and Particle Physics:

Basic nuclear properties: size, shape, charge distribution, spin and parity; Binding energy, semi-empirical mass formula; Liquid drop model; Fission and fusion; Nature of the nuclear force, form of nucleon-nucleon potential; Charge-independence and charge-symmetry of nuclear forces; lsospin; Deuteron problem; Evidence of shell structure, single- particle shell model, its validity and limitations; Rotational spectra; Elementary ideas of alpha, beta and gamma decays and their selection rules; Nuclear reactions, reaction mechanisms, compound nuclei and direct reactions; Classification of fundamental forces; Elementary particles (quarks, baryons, mesons, leptons); Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula; C, P, and T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic kinematics.

Crystalline and amorphous structure of matter; Different crystal systems, space groups; methods of determination of crystal structure; X-ray diffraction, scanning and transmission electron microscopes; Band theory of solids-conductors, insulators and semiconductors; Thermal properties of solids, specific heat, Debye theory; Magnetism: dia, para and ferromagnetism; elements of superconductivity; Meissner effect, Josephson junctions and applications; elementary ideas about high temperature superconductivity.

c. Electromagnetic Theory:

Electrostatics: Gauss' Law and its applications; Laplace and Poisson equations, boundary value problems; Magnetostatics: Biot-Savart law, Ampere's theorem, electromagnetic induction; Maxwell's equations in free space and linear isotropic media; boundary conditions on fields at interfaces; Scalar and vector potentials; Gauge invariance; Electromagnetic waves in free space, dielectrics, and conductors; Reflection and refraction, polarization, Fresnel's Law, interference, coherence, and diffraction; Dispersion relations in plasma; Lorentz invariance of Maxwell's equations; Transmission lines and wave guides; Dynamics of charged particles in static and uniform electromagnetic fields; Radiation from moving charges, dipoles and retarded potentials

d. Classical Mechanics:

Newton's laws; Phase space dynamics, stability analysis; Central-force motion; Two-body collisions, scattering in laboratory and centre-of-mass frames; Rigid body dynamics, moment of inertia tensor, non-inertial frames and pseudoforces; Variational principle, Lagrangian and Hamiltonian formalisms and equations of motion; Poisson brackets and canonical transformations; Symmetry, invariance and conservation laws, cyclic coordinates; Periodic motion, small oscillations and normal modes; Special theory of relativity, Lorentz transformations, relativistic kinematics and mass-energy equivalence. .

GEOPHYSICS - PAPER III : 200 Marks

PART-A: 100 Marks

a. Radiometric Exploration / Airborne Geophysical surveys for Geological Mapping:

Principles of radioactivity, radioactivity decay processes, units, radioactivity of rocks and minerals, Instruments, Ionisation chamber, G-M counter, Scintillation meter, Gamma ray spectrometer,

Radiometric prospecting for mineral exploration (Direct/Indirect applications), Radiometric prospecting for beach placers, titanium, zirconium and rare-earths, portable gamma ray spectrometry and radon studies in seismology, environmental Applications, logging methods, radiometric dating techniques. Airborne geophysical surveys, planning of surveys, sensors, data corrections, flight path recovery methods, applications in geological mapping, interpretation of maps, identification of structural features, altered zones.

b. Marine Geophysics:

Oceans and Seas, origin of continents and oceans, salinity, temperature and density of sea water. Introduction to Sea-floor features: Physiography, divisions of sea floor, continental shelves, slopes, aprons and abyssal planes, growth and decline of ocean basins, turbidity currents, submarine sedimentation and stratigraphy, occurrence of mineral deposits and hydrocarbons in offshore. Geophysical surveys and instrumentation, Gravity and Magnetic surveys, Instrumentation used in ship borne surveys, towing cable and fish, data collection and survey procedures, corrections and interpretation of data. Oceanic magnetic anomalies, sea floor spreading, Vine-Mathews hypothesis, geomagnetic time scale and dating sea floor, linear magnetic anomalies, Oceanic heat flow, ocean ridges, basins, marginal basins, rift valleys. Seismic surveys, energy sources, Finger, Boomer, Sparker, Exploder, Air gun, Vapour cook, Hydrophones, processing, data reduction and interpretation. Bathymetry, echo sounding, bathymetric charts, sea bed mapping, seabed sampling, dredging and coring, Navigation methods and Position location methods.

c. Geophysical Signal Processing:

Various types of signals, sampling theorem, aliasing effect, Fourier series and periodic waveforms, Fourier transform and its properties, Discrete Fourier transform and **FFT,** Auto and cross correlations, Power spectrum, Delta function, unit step function. Time domain windows, Z transform and properties, Inverse Z transform. Principles of digital filters, types of filters, moving average and recursive and non recursive filters Amplitude and phase response filters low pass, band pass and high pass filters, Processing of Random signals. Signal enhancement for gravity and magnetic maps; regional residual separation, continuations, evaluation of derivatives, pseudo gravity transformations, reduction to poles and equator, Improvement of signal to noise ratio, source and geophone arrays as spatial filters. Earth as low pass filter.

d. Remote Sensing and GIS applications:

Fundamental concepts of remote sensing, electromagnetic radiation spectrum, energy-frequency-wavelength relationship, Boltzman Law, Wien Law, electromagnetic energy and its interactions in the atmosphere and with terrain features; elements of photographic systems, reflectance and emittance, false color composites, remote sensing platforms, flight planning, geosynchronous and sun synchronous orbits, sensors, resolution, parallax and vertical exaggeration, relief displacement, mosaic, aerial photo interpretation and geological application. Fundamentals of photogrammetry, satellite remote sensing, multi-spectral scanners, thermal scanners, microwave remote sensing, fundamental of image processing and interpretation for geological applications. Introduction to Geographic Information Systems (GIS) spatial data structures, visualization and querying, spatial data analysis.

PART-B: 100 Marks

a. Solid State Physics:

Crystalline and amorphous structure of matter; Different crystal systems, space groups; methods of determination of crystal structure; X-ray diffraction, scanning and transmission electron microscopes; Band theory of solids-conductors, insulators and semiconductors; Thermal properties of solids, specific heat, Debye theory; Magnetism: dia, pars and ferromagnetism; elements of superconductivity; Meissner effect, Josephson junctions and applications; elementary ideas about high temperature superconductivity.

b. Laser systems: Light amplification and relation between Einstein A and B coefficients. Rate equations for three level and four level systems. Ruby laser, Nd-YAG laser, CO2 laser, Dye laser, Excimer laser, Semiconductor laser.

c. Laser cavity modes: Line shape function and full width at half maximum (FWHM) for natural broadening, collision broadening, Doppler broadening, saturation behaviour of broadened transitioins, longitudinal and transverse modes. ABCD matrices and cavity stability criteria for confocal resonators. Quality factor, Q-switching, mode locking in lasers. Expression for intensity for modes oscillating at random and modes locke in phase. Methods of Q-switching and mode locking. Optical fiber waveguides, Fiber characteristics.

d. Electronics and devices:

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo and hetero junction devices) device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo detectors, LEDs) Operational amplifiers and their applications. Digital techniques and applications (registers, counters, comparators and similar circuits). A/D and D/A converters. Microprocessor and microcontroller basics. Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least square fitting. Intrinsic extrinsic semiconductors, pn-p and n-p-n

transistors; Amplifiers and oscillators; Op-amps; FET, JFET and MOSFET; Digital electronics-Boolean identities, De morgan's laws, logic gates and truth tables; simple logic circuits; thermistors, solar cells, fundamentals of microprocessors and digital computers.

e. Digital electronics, Radar systems, Satellite communications:

Digital circuits, Number systems and codes, Combination logic circuits, sequential logic circuits, microprocessor architecture, functional diagram, Pin description, Timing diagram of read cycle, timing diagram of write cycle. Data transfer techniques-Serial transfer, parallel transfer etc. Radar systems, signal and data processing, satellite communication-Fundamentals Designing a surveillance radar, tracking radar, signal and data processing, radar antenna parameters, satellite systems-communication satellite systems, communication satellites, orbiting satellites, satellite frequency bands, satellite orbit and inclinations. Multiple access techniques, earth station technology.

f.Quantum Mechanics:

Wave-particle duality; Wave functions in coordinate and momentum representations; Commutators and Heisenberg's uncertainty principle; Matrix representation; Dirac's bra and ket notation; Schroedinger equation (time-dependent and time-independent); Eigen value problems such as particle-in-a-box, harmonic oscillator, etc.; Tunneling through a barrier; Motion in a central potential; Orbital angular momentum, Angular momentum algebra, spin; Addition of angular momentum; Hydrogen atom, spin-orbit coupling, fine structure; Time-independent perturbation theory and applications; Variational method; WKB approximation; Time dependent perturbation theory and Fermi's Golden Rule; Selection rules; Semi-classical theory of radiation; Elementary theory of scattering, phase shifts, partial waves, Born approximation; Identical particles, Pauli's exclusion principle, spin-statistics connection; Relativistic quantum mechanics: Klein Gordon and Dirac equations.

CHEMISTRY PAPER-I (Inorganic Chemistry): 200 Marks

Chemical periodicity:

Periodic table, group trends and periodic trends in physical properties. Classification of elements on the basis of electronic configuration. Modern IUPAC Periodic table. General characteristic of s, p, d and f block elements. Effective nuclear charges, screening effects, atomic radii, ionic radii, covalent radii. Ionization potential, electron affinity and electro-negativity. Group trends and periodic trends in these properties in respect of s-, p- and d-block elements. General trends of variation of electronic configuration, elemental forms, metallic nature, magnetic properties, catenation and catalytic properties, oxidation states, aqueous and redox chemistry in common oxidation states, properties and reactions of important compounds such hydrides, halides, oxides, oxy-acids, complex chemistry in respect of s-block and p-block elements.

Chemical Bonding and structure:

Ionic bonding: Size effects, radius ratio rules and their limitations. Packing of ions in crystals, lattice energy, Born-lande equation and its applications, Born-Haber cycle and its applications. Solvation energy, polarizing power and polarizability, ionic potential, Fazan's rules. Defects in solids. Covalent bonding: Lewis structures, formal charge. Valence Bond Theory, Molecular orbital Theory, hybridizations, VSEPR theory. Partial ionic Character of covalent bonds, bond moment, dipole moment and electro negativity differences. Concept of resonance, resonance energy, resonance structures. Schrodinger equation for the H-atom.

Coordinate bonding: Werner theory of coordination compounds, double salts and complex salts, Lewis acid-base. Ambidentate and polydentate ligands, chelate complexes. IUPAC nomenclature of coordination compounds. Coordination numbers, Geometrical isomerism. Stereoisomerism in square planar and octahedral complexes. Hydrogen bonding. Metallic bonding: qualitative idea of band theory, conducting, semi conducting and insulating properties.

Chemistry of coordination compounds:

Isomerism, reactivity and stability: Determination of configuration of cis- and trans- isomers by chemical methods. Labile and inert complexes, substitution reaction on square planer complexes, trans effect. Stability constants of coordination compounds and their importance in inorganic analysis. Structure and bonding: Elementary Crystal Field Theory: splitting of do configurations in octahedral, square planar and tetrahedral fields, crystal field stabilization energy; pairing energy. Jahn- Teller distortion. Metal-ligand bonding, sigma and pi bonding in octahedral complexes and their effects on the oxidation states of transitional metals . Orbital and spin magnetic moments, spin only moments of and their correlation with effective magnetic moments, d-d transitions; LS coupling, spectroscopic ground states, selection rules for electronic spectral transitions; spectro-chemical series of ligands; charge transfer spectra .

Acid-Base reactions

Acid-Base concept: Arrhenius concept, theory of solvent system, Bronsted-Lowry's concept, relative strength of acids, Pauling rules. Lewis concept. Acidbase equilibria in aqueous solution and pH. Acid-base neutralisation curves; indicator, choice of indicators.

Precipitation and Redox Reactions:

Solubility product principle, common ion effect. Ion-electron method of balancing equation of redox reaction. Standard redox potentials, Nernst equation. Influence on complex formation, precipitation and change of pH on redox potentials; formal potential. Feasibility of a redox titration, redox potential at the equivalence point, redox indicators. Redox potential diagram of common elements and their applications. Disproportionation and comproportionation reactions.

Organo metallic compounds:

18-electron rule and its applications to carbonyls, nitrosyls, cyanides, and nature of bonding involved therein. Simple examples of metal-metal bonded compounds and metal clusters. Metal-olefin complexes: zeises salt, Ferrocene.

Nuclear chemistry:

Radioactive decay - General characteristics, decay kinetics, parent -daughter decay growth relationships, determination of half-lives, Nuclear models -shell model, liquid drop model, Fermi gas model, Collective model and optical model. Nuclear stability. Decay theories. Nuclear reactions- fission, fusion and spallation reactions. Definition of curie and related calculations, preparation of artificial radionuclides by bombard-ment, radiochemical separation techniques. Experimental techniques in the assay of radioisotopes, gas filled detectors-ionization chamber, proportional and Geiger-Muller counters -G.M. Plateau, dead time, coincidence loss, determination of dead time, scintillation counters, solid state detectors.

s-Block Elements :

Hydride , hydration energies, solvation and complexation tendencies of alkali and alkaline-earth metals, principle of metallurgical extraction, Chemistry of Li and Be, their anomalous behaviour and diagonal relationships, alkyls and aryls.

p-Block Elements :

Comparative study of group 13 & 14 elements with respect to periodic properties. Compounds such as hydrides, halides, oxides and oxyacids; diagonal relationship; preparation, properties, bonding and structure of diborane, borazine and alkalimetal borohydrides. Preparation, properties and technical applications of carbides and fluorocarbons. Silicones and structural principles of silicates.

Chemistry of d- and f- block elements:

General comparison of 3d, 4d and 5d elements in term of electronic configuration, elemental forms, metallic nature, atomization energy, oxidation states, redox properties, coordination chemistry, spectral and magnetic properties. f-block elements: electronic configuration, ionization energies, oxidation states, variation in atomic and ionic (3+) radii, magnetic and spectral properties of lanthanides, comparison between lanthanide and actinides, separation of lanthanides (by ion-exchange method). Chemistry of some representative compounds: K2Cr2O7, KMnO4, K4[Fe(CN)6], K2[Ni(CN)4], H2PtC16, Na2[Fe(CN)5N0].

CHEMISTRY PAPER-II (Physical Chemistry) :200

Kinetic theory and the gaseous state:

Gaseous state: Gas laws, kinetic theory of gas, collision and gas pressure, derivation of gas laws from kinetic theory, average kinetic energy of translation, Boltzmann constant and absolute scale of temperature. Maxwell's distribution of speeds. Kinetic energy distribution, calculations of average, root mean square and most probable velocities. Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases.

Collision of gas molecules, Real gases:

Collision diameter; collision number and mean free path; frequency of binary collisions; wall collision and rate of effusion. Real gases, Deviation of gases from ideal behaviour; compressibility factor; Andrew's and Amagot's plots; van der Waals equation and its characteristic features. Existence of critical state. Critical constants in terms of van der Waals constants. Law of corresponding state and significance of second virial coefficient. Boyle temperature. Intermolecular forces.

Liquid state: physical properties of liquids and their measurements: surface tension and viscosity

Solids: Nature of solid state, law of constancy of angles, concept of unit cell, different crystal system, Bravais lattices, law of rational indices, Miller indices, symmetry elements in crystals. X-ray diffraction, Bragg's law, Laue's method, powder method, radius ratio and packing in crystals.

Thermodynamics:

Definition of thermodynamic terms. Thermodynamic functions and their differentials. Zeroth law, First law and Second law of thermodynamics. Cyclic, reversible and irreversible processes. Internal energy (U) and enthalpy

(H); relation between Cp and Cv, calculation of w, q, ?U and ?H for expansion of ideal gas under isothermal and adiabatic conditions for reversible and irreversible processes including free expansion. Joule-Thomson Coefficient and inversion temperature. Application of First law of thermodynamics.

Application of Second law of thermodynamics.

Carnot cycle and its efficiency, Gibbs function (G) and Helmholtz function (A), Gibbs-Helmholtz equation, criteria for thermodynamic equilibrium and spontaneity of a process. Chemical equilibrium: chemical equilibria of homogeneous and heterogeneous systems, derivation of expression of equilibrium constants, Le Chatelier's principle of dynamic equilibrium.

Thermodynamics and Equilibrium:

Chemical potential in terms of Gibb's free energy and other thermodynamic state functions and its variation with temperature and pressure. Gibbs-Duhem equation; fugacity of gases and fugacity coefficient. Thermodynamic conditions for equilibrium, degree of advancement. Van't Hoffs reaction isotherm. Equilibrium constant and standard Gibbs free energy change. Definitions of KP, KC and Kx; van't Hoffs reaction isobar and isochore. Le Chatelier's principle. Activity and activity coefficients of electrolyte / ion in solution. Debye-Huckel limiting law.

Acids-bases and solvents:

Modern aspects of acids and bases: Arrhenius theory, theory of solvent system, Bronsted and Lowry's concept, Lewis concept with typical examples, applications and limitations. Strengths of acids and bases. Ionization of weak acids and bases in aqueous solutions, application of Ostwald's dilution law, ionization constants, ionic product of water, pH-scale, buffer solutions and their pH values, buffer actions & buffer capacity; hydrolysis of salts.

Solutions of non-electrolytes: Colligative properties of solution, Raoult's Law, relative lowering of vapor pressure, osmosis and osmotic pressure; elevation of boiling point and depression of freezing point of solvents.

Chemical kinetics and catalysis:

Order and molecularity of reactions, rate laws and rate equations for first order and second order reactions; zero order reactions. Parallel and consecutive reactions. Determination of order of reactions. Temperature dependence of reaction rate, energy of activation. Enthalpy of activation, entropy of activation , effect of dielectric constant and ionic strength of reaction rate, kinetic isotope effect; collision theory & transition State Theory of reaction rate, Catalytic reactions.

Adsorption and Surface Chemistry:

Physisorption & Chemisorption, adsorption isotherms, Freundlich and Langmuir adsorption isotherm, BET equation, surface area determination, heterogeneous catalysis; colloids, electrical double layer and colloid stability, electro-kinetic phenomenon; elementary ideas about soaps & detergents, micelles, emulsions.

Electrochemistry:

Conductance: cell constant, specific conductance and molar conductance. Kohlrausch's law of independent migration of ions, ion conductance and ionic mobility. Equivalent and molar conductance at infinite dilution. Ostwald's dilution law. Debye-Huckel theory. Application of conductance measurement. Conductometric titrations. Determination of transport number by moving boundary method. Types of electrochemical cells, cell reactions, emf and change in free energy, 6.H and AS of cell reactions. Nernst equation. Standard cells. Half-cells /electrodes, different types of electrodes. Standard electrode potential and principles of its determination. Types of concentration cells. Liquid junction potential. Glass electrode and determination of pH of a solution. Potentiometric titrations: acid-base and redox, electro chemical power sources; primary, secondary and fuel Cells, corrosion and inhibition of corrosion.

Photochemistry :

Frank-Condon principle and vibrational structure of electronic spectra. Bond dissociation and principle of determination of dissociation energy. Decay of excited states by radiative and non-radiative paths. Fluorescence and phosphorescence, Jablonsky diagram. Laws of photochemistry: Grotthus-Draper law, Stark-Einstein law of photochemical equivalence and Lambert-Beers law; quantum yield and its measurement for a photochemical process, actinometry. Photostationary state. Photosensitized reactions. Kinetics of HI decomposition, H2-Br2 reaction, dimerisation of anthracene.

Quantum Chemistry:

Wave-particle duality, Photoelectric and Compton effects, de Broglie hypothesis. Eigenfunctions and eigenvalues. Uncertainty relation, Expectation value. Hermitian operator. Schrodinger time-independent equation: nature of the equation, acceptability conditions imposed on the wave functions and probability interpretations of wave function. Schrodinger equation for one-dimensional box and its solution. Comparison with free particle eigenfunctions and eigenvalues.

Basic principles and application of spectroscopy:

Electromagnetic radiation, interaction with atoms and molecules and quantization of different forms of energies. Condition of resonance and energy of absorption for various types of spectra; origin of atomic spectra, spectra of hydrogen atoms, many electron atoms, spin and angular momentum. Rotational spectroscopy of diatomic molecules: rigid rotor model, selection rules, spectrum, characteristic features of spectral lines. Determination of bond length, effect of isotopic substitution. Vibrational spectroscopy of diatomic molecules: Simple Harmonic Oscillator model, selection rules, Raman Effect. Characteristic features and conditions of Raman activity with suitable illustrations. Rotational and vibrational Raman spectra.

UV Spectra: Electronic transition (a-a*, n-u*, IT-1T" and n-n'), relative positions of Amax considering conjugative effect, steric effect, solvent effect, red shift (bathochromic shift), blue shift (hypsochromic shift), hyperchromic effect, hypochromic effect (typical examples). IR Spectra: Modes of molecular vibrations, application of Hooke's law, characteristic stretching frequencies of O-H, N-H, C-H, C-D, C=C, C=N, C=0 functions; factors effecting stretching frequencies

PMR Spectra: Nuclear spin, NMR active nuclei, principle of proton magnetic resonance, equivalent and non-equivalent protons, chemical shift ?), shielding / deshielding of protons, up-field and down-field shifts. NMR peak area, diamagnetic anisotropy, relative peak positions of different kinds of protons, substituted benzenes.

CHEMISTRY PAPER-III:200 Marks

PART-A (Analytical Chemistry): 100 Marks

Theoretical basis of Quantitative inorganic analysis:

Law of mass action, chemical and ionic equilibrium, solubility, Solubility product and common ion effect, effect of temperature upon the solubility of precipitates, the ionic product of water, pH, effect of temperature on pH, Salt hydrolysis, hydrolysis constant, degree of hydrolysis, buffer solutions, different types of buffers and Henderson's equation.

Gravimetric Analysis:

General principles, stoichiometry, calculation of results from gravimetric data. Properties of precipitates. Nucleation and crystal growth, factors influencing completion of precipitation. Co-precipitation and post-precipitation, purification and washing of precipitates. Precipitation from homogeneous solution, a few common gravimetric determinations-chloride as silver chloride, sulphate as barium sulphate, aluminum as the oxinate and nickel as dimethyl glyoximate.

Sampling and treatment of samples for chemical analysis:

Techniques of collection of Solids, liquids and gaseous samples, dissolution of solid samples, attack with water, acids, and alkalis, fusion with Na2CO3, NaOH, Na202, K2S207; Microwave assisted digestion techniques(Only elementary idea) **Volumetric Analysis:**

Equivalent weights, different types of solutions, Normal solutions, Molar solutions, and molal solutions and their inter relations. Primary and secondary standard substances. principles of different type of titrations-i) acid-base titration, ii) redox titration, iii) complexometric titrations. Types of indicators - i) acid-base, ii) redox iii) metal-ion indicators. Principles in estimation of mixtures of NaHCO3 and Na2CO3 (by acidimetry); Principles of estimation of iron, copper, manganese, chromium (by redox titration);

Acid base titrations: Principles of titrimetric analysis, titration curves for strong acid-strong base, weak acid-strong base and weak base-strong acid titrations, poly protic acids, poly equivalent bases, determining the equivalence point-theory of acid base indicators, colour change range of indicator, selection of proper indicator.

Redox Titrations: Principles behind the lodometry, permaganometry, dichrometry, difference between iodometry and iodimetry.

Potentiometry: Fundamentals of potentiometry. indicator and ion-selective electrodes. Membrane electrodes. Glass electrode for pH measurement, glass electrodes for cations other than protons. Liquid membrane electrodes, solid state ion selective detectors and biochemical electrodes. Applications of potentiometry. Direct potentiometric measurements-determination of pH and fluoride. Redox and potentiometer titrations- Balancing redox reactions, calculation of the equilibrium constant of the reaction, titration curves, visual end point detection. Redox indicators-theory, working and choice. Potentiometric end point detection. Applications of redox titrations.

Complexometric titrations: Complex formation reactions, stability of complexes, stepwise formation constants, chelating agents, EDTA-acidic properties, complexes with metal ions, equilibrium calculations involving EDTA, conditional formation constants, derivation of EDTA titration curves, effect of other complexing agents, factors affecting the shape of titration curves-completeness of reaction, indicators for EDTA titrations-theory of common indicators, titration methods employing EDTA-direct, back and displacement titrations, indirect determinations, titration of mixtures, selectivity, masking and de-masking agents, typical

applications of EDTA titrations-hardness of water, magnesium and aluminium in antacids, magnesium, manganese and zinc in a mixture, titrations involving uni-dentate ligands-titration of chloride with Hg2+ and cyanide with Ag+.

Chromatographic methods of analysis:

Basic principles and classification of chromatography. Importance of column chromatography and thin layer chromatography; Theory and principles of High Performance Liquid Chromatography (HPLC) and Gas Liquid Chromatography (GLC). Ion-exchange chromatography.

UV-Visible Spectroscopy:

Basic Principles of UV-Vis spectrophotometer. Lambert -Beer's Law and its limitations. Instrumentation consisting of source, monochromator, grating and detector. Spectrophotometric determination.

Flame photometry and Atomic absorption spectrometry:

Emission spectra Vs absorption spectra. Basic Principles and theory of flame photometry. Applications of Flame photometers. Basic Principles and theory of AAS. Three different modes of AAS - Flame-MS, VGAAS, and GFAAS. Single beam and double beam AAS. Function of Halo Cathode Lamp (HCL) and Electrode Discharge Lamp (EDL). Different types of detectors used in MS. Different types of interferences-Matrix interferences, chemical interferences, Spectral interferences and background correction in AAS. Use of organic solvents. Quantitative techniques-calibration curve procedure and the standard addition technique. Typical commercial instruments for FP and MS. Applications. Qualitative and qualitative analysis. Relative detection abilities of atomic absorption and flame emission spectrometry.

X-ray methods of Analysis:

Introduction , theory of X-ray generation, X-ray spectroscopy, X-ray diffraction and X-ray fluorescence methods, Braggs law, instrumentation , dispersion by crystals, applications. Preparation of pallets, glass beads, quantitative and qualitative measurement.

Inductively coupled plasma spectroscopy:

Theory and Principles, plasma generation, utility of peristaltic pump, sampler - skimmer systems, ion lens, quadrupole mass analyzer, dynode /solid state Detector, different type of interferences- spectroscopic and non-spectroscopic interferences, isobaric and molecular interferences, applications.

Analysis of Minerals, Ores and Alloys:

Analysis of Minerals and Ores- estimation of (i) CaCO3 , MgCO3 in dolomite (ii) Fe203, Al203, and TiO2 in Bauxite.(iii) MnO and Mn02 in Pyrolusite.

Analysis of Metal and Alloys: (i) Cu and Zn in Brass (ii) Cu, Zn, Fe, Mn, Al and Ni in Bronze (iii) Cr, Mn, Ni, and P in Steel (iv) Pb, Sb, Sn in type metal.

Analysis of petroleum and petroleum products:

Introduction, constituents and petroleum fractionation. Analysis of petroleum products-specific gravity, viscosity, Doctor test, aniline point, colour determination, cloud point, pour point. Determination of water, neutralization value (acid and base numbers), ash content, Determination of lead in petroleum.

Analysis of coal and coke-Types, composition, preparation of sample, proximate and ultimate anlaysis calorific value by bomb Calorimetry.

PART-B (Organic Chemistry): 100 Marks

Basic organic chemistry:

Inductive effect, resonance and resonance energy. Homolytic and heterolytic bond breaking, electrophiles and nucleophiles; carbocations, carbanions and radicals (stability and reactivity). Alkanes, alkenes and alkynes: Synthesis and chemical reactivity of alkanes, mechanism of free-radical halogenation of alkanes. General methods of synthesis, electrophilic addition reactions and polymerization reaction (definition and examples only) of alkenes. General methods of synthesis, acidity, hydration and substitution reactions of alkynes.

Organometallic compounds:

Grignard reagents - preparations and reactions, application of Grignard reagents in organic synthesis. Organic compounds containing nitrogen: aromatic nitro compounds - reduction under different conditions. Methods of synthesis of aliphatic amines, Heinsberg's method of amine separation, Hofmann degradation, Gabriel's phthalimide synthesis, distinction of primary, secondary and tertiary amines; methods of synthesis of aromatic amines, basicity of aliphatic and aromatic amines. Sandmeyer reactions; synthetic applications of benzene diazonium salts.

Bonding and physical properties:

Valence bond theory: concept of hybridisation, resonance (including hyperconjugation), orbital pictures of bonding sp3, sp2, sp: C-C, C-N & C-0 system). Inductive effect, bond polarization and bond polarizability, steric effect, steric inhibition of resonance. MO theory: sketch and energy levels of MOs of i) acyclic p orbital system ii) cyclic p orbital system, iii) neutral system. Frost diagram, Huckel's rules for aromaticity &

antiaromaticity; homoaromaticity. Physical properties: bond distance, bond angles, mp/bp & dipole moment in terms of structure and bonding. Heat of hydrogenation and heat of combustion.

Aldol and related reactions:

Keto-enol tautomerism, mechanism and synthetic applications of aldol condensations, Claisen reaction, Schmidt reaction, Perkin reaction, Knovenogal, benzoin, Cannizaro reaction, Michael addition. Aromatic substitution reactions - electrophilic, nucleophilic and through benzynes - radical substitution of arenes - orientation of nucleophilic substitution at a saturated, carbon, SN1, SN2, SNi reactions -effect of structure, nucleophile, leaving group, solvent. Additions involving electrophiles, nucleophiles and free radicals.

Mechanism of some name reactions:

Aldol, Perkin, Benzoin, Cannizaro, Wittig, Grignard, Reformatsky, Hoffmann, Claisen and Favorsky rearrangements. Openauer oxidation, clemmensen reduction, Meerwein - Pondorf and Verley and Birch reductions. Stork enamine reactions, Michael addition, Mannich Reaction, Diels - Alder reaction.

Electrocyclic Reactions:

Molecular orbital symmetry, frontier orbitals of ethylene, 1,3 Butadiene, 1,3,5- Hexatriene, ally! system, classfication of pericyclic reactions FMO approach, Woodwrd- Hoffman correlation diagram method and perturbation of molecular (PMO) approach for the explanation of pericyclic reactions under thermal and photochemical conditions. Conrotatory and disotatory motions (4n) and (4n+2).

Organic Reaction Mechanisms:

Addition Elimination Mechanisms: (a) Addition to carbon multiple bonds- hydrogenation of double and triple bonds, hydroboration, birch reduction, Michael reaction, addition of oxygen and N, (b) Addition to carbon-hetero atom multiple bonds: Mannich reaction,Reductions of Carbonyl compounds, acids, esters, nitrites, addtion of Grignard reagents, Reformatsky reaction, Tollen's reaction, Wittig reaction: (c) Elimination reactions: Stereochemistry of eliminations in acyclic and cyclic systems, orientation in eliminations - Saytzeff and Hoffman elimination.

Organic Spectroscopy:

Infrared spectroscopy: Units of frequency wave length and wave number, molecular vibrations, factors influencing vibrational frequencies, the IR spectrometer, characteristic frequencies of organic molecules and interpretation of spectra. Ultraviolet spectroscopy: Introduction, absorption laws, measurement of the spectrum, chromophores, definitions, applications of UV spectroscopy to Conjugated dines, trienes, unsaturated carbonyl compounds and aromatic compounds. Nuclear Magnetic Resonance Spectroscopy: (Proton and Carbon -13 NMR) The measurement of spectra, the chemical shift: the intensity of NMR signals and integration factors affecting the chemical shifts: spin-spin coupling to 13C IH-IH first order coupling: some simple IH-IH splitting patterns: the magnitude of IH-IH coupling constants.

Mass spectroscopy: Basic Principles: instrumentation: the mass spectrometer, isotope abundances; the molecular ion, meta stable ions.

HYDROGEOLOGY 200 Marks

Section A: Origin, occurrence and distribution of water.

Water on earth; Types of water — meteoric, juvenile, magmatic and sea water; Hydrological Cycle and its components; Water balance; Water-bearing properties of rocks — porosity, permeability, specific yield and specific retention; Vertical distribution of water; Zone of aeration and zone of saturation; Classification of rocks according to their water-bearing properties; Aquifers; Classification of aquifers; Concepts of drainage basins and groundwater basins; Aquifer parameters- transrnissivity and storage coefficient; Water table and piezometric surface; Fluctuations of water table and piezometric surface; Barometric and tidal efficiencies; Water table contour maps; Hydrographs; Springs; Geologic and geomorphic controls on groundwater; Hydrostratigraphic units;Groundwater provinces of India. Hydrogeology of arid zones of India;Hydrogeology of wet lands.

Section B: Groundwater Hydraulics

Theory of groundwater flow; Darcy's law and its applications; Determination of permeability in laboratory and in field; Flow through aquifers; steady, unsteady and radial flow conditions; Evaluation of aquifer parameters of confined, semi-confined and unconfined °aquifers -Thiem, Thies, Jacob and Walton's methods; Groundwater modelling.

Section C: Groundwater Exploration and Water Well Construction

Geologic and hydrogeologic methods of exploration; Role of remote sensing in groundwater exploration; Hydrogeomorphic and lineament 'napping; Surface geophysical methods — seismic, gravity, geo-electrical and magnetic methods; Types of water wells and methods of construction; Design, development, maintenance and revitalization of wells; Sub-surface geophysical methods; Yield characteristics of wells; Pumping tests- methods, data analysis

and interpretation;

Section D: Groundwater Quality

Physical and chemical properties of water; Quality criteria for different uses; Graphical presentation of groundwater quality data; Groundwater quality in different provinces in India; Groundwater contamination; natural (geogenic) and anthropogenic contaminants; Saline water intrusion; Radio-isotopes in hydroLteological studies.

Section E: Groundwater Management

Groundwater problems related to foundation work, mining, canals and tunnels; Over-exploitation of groundwater and groundwater mining; Groundwater problems in urban areas; Ground water management in arid and semi arid areas; Climate change impact on graoundwater resources; Concept of sustainable development of groundwater resources; Groundwater management —supply side and demand side management; Rainwater harvesting and managed aquifer recharge; Conjunctive use of surface and groundwater; Groundwater legislation.

APPENDIX-II-

INSTRUCTIONS TO THE CANDIDATES FOR FILLING ONLINE APPLICATIONS

- Candidates are required to apply Online using the website http://www.upsconline.nic.in.
- Salient features of the system of Online Application Form are given hereunder:
- Detailed instructions for filling up online applications are available on the above mentioned website.
- Candidates will be required to complete the Online Application Form containing two stages viz. Part-I and Part-II as per the instructions available in the above mentioned site through drop down menus.
- The candidates are required to pay a fee of Rs.200/- Rupees Two Hundred only) [excepting SC/ST/ Female/Persons with Benchmark Disability candidates who are exempted from payment of fee] either by depositing the money in any branch of State Bank of India by cash, or by using net banking facility of State Bank of India or by using any Visa/Master/RuPay Credit/ Debit Card.
- Before start filling up Online Application, a candidate must have his photograph and signature duly scanned in the .jpg format in such a manner that each file should not exceed 300 KB each and must not be less than 20 KB in size for the photograph and signature.
- The candidate should have details of one Photo ID viz. Aadhar Card/ Voter Card / PAN Card / Passport/ Driving License / Any other photo ID Card issued by the State / Central Government. The details of this photo ID will have to be provided by the candidate while filling up the online application form. This photo ID will be used for all future references and the candidate is advised to carry this ID while appearing for the examination.
- The Online applications (Part I and II) can be filled from 20th March, 2019 to 16th April, 2019 till 18:00 Hrs.
- Applicants should avoid submitting multiple applications. However, if due to any unavoidable circumstances, any applicant submits multiple applications then he/she must ensure that the applications with higher RID is complete in all respects.
- In case of multiple applications, the applications with higher RID shall be entertained by the Commission and fee paid against one RID shall not be adjusted against any other RID.

- The applicants must ensure that while filling their Application Form, they are providing their valid and active E-Mail IDs as the Commission may use electronic mode of communication while contacting them at different stages of examination process.
- The applicants are advised to check their emails at regular intervals and ensure that the email addresses ending with @ nic.in are directed to their inbox folder and not to the SPAM folder or any other folder.
- Candidates are strongly advised to apply online well in time without waiting for the last date for submission of Online Applications.
- **Moreover, the Commission has introduced provision of withdrawal of application for the candidate, who does not want to appear at the Examination, he/she may withdraw his/her application.**

Appendix-II (B)

IMPORTANT INSTRUCTIONS TO WITHDRAW APPLICATION

1. Candidates are advised to go through the instructions carefully before filling up the request for withdrawal of application.

2. The Commission has provided the withdrawal facility from 23.04.2019 to 30.04.2019 (till 6.00 PM) to those candidates who do not want to appear at this Examination.

3. Candidates are advised to provide the details of registered application with registration-id which was completed and submitted finally. There is no provision for withdrawing of incomplete applications.

4. Before making the request for withdrawal, candidate must ensure that they have access to the registered mobile number and email-id which were provided by them at the time of submission of application. Separate OTPs will be sent by the Commission on the registered mobile number and email-id. Request for withdrawal will be accepted only after it is confirmed by validating the OTP details sent on candidate's mobile and email-id. Such OTPs will be valid for 30 Minutes only.

5. Request for generating OTP for withdrawal of application will be accepted only till 5.30 PM on 30.04.2019.

6. If a candidate has submitted more than one application form then the higher registration-id of Application (latest) will be considered for withdrawal and all earlier applications will be treated as cancelled automatically.

7. After the final acceptance of the request for online withdrawal of application, the candidate must print the authenticated receipt. Once application has been withdrawn by the candidate, it cannot be revived in future.

8. UPSC has no provision to refund any fee amount paid by candidates, so in case of successful withdrawal of application the fees will not be refunded.

9. On successful completion of withdrawal of application, an auto-generated email and SMS will be sent on candidate's registered email-id and mobile. In case any candidate

has not submitted the request for withdrawal of application he/she may contact UPSC on email-id: upscsoap@nic.in immediately.

10. Candidates are advised not to share the OTPs received on email and SMS to anybody.

APPENDIX III

SPECIAL INSTRUCTIONS FOR CONVENTIONAL TYPE PAPERS

1. Articles permitted inside Examination Hall

Battery-operated pocket calculators of "non-programmable" type only, mathematical/engineering/ drawing instruments, including a flat rule divided on the edges into inches and tens of an inch and into centimeters and millimeters, a slide rule, set squares, a protractor and a pair of compasses, pencils, coloured pencils, mapping pens, eraser, T-square and drawing board for use wherever necessary. Candidates are not allowed to bring with them any "Tables or Charts" for use in the Examination Hall.

Mobile phones, bluetooth or any other communication devices are not allowed inside the premises where the examination is being conducted. Any infringement of these instructions shall entail disciplinary action including ban from future examinations. Candidates are advised in their own interest not to bring any of the banned items including mobile phones to the venue of the examination, as arrangements for safekeeping cannot be assured.

2. Tables to be supplied by UPSC

If it is considered necessary for answering the questions set in any paper, the Commission may supply any of the following for reference purpose only:-

(i) Mathematical/Physical, Chemical and Engineering Tables (including Logarithmic Tables);
Steam Table (including Mollier Diagrams for Temperature up to 800° C and Pressure up
500 Kgf/Cm);
(ii) National Building Code of India 1970 or 1983 Group 2 Part VI;
(iii) Any other special articles as may be necessary for the candidates to answer the questions set in the question paper.

After conclusion of the examination, return the above items to the Invigilator.

3. Answers to be written in own hand

Write the answers in your own hand in ink. Pencil may be used for maps, mathematical drawings or rough work.

4. Check Answer Book

The candidate must write his/her roll number (and not his/her name) only in the
space provided for the purpose on every answer book used by him/her. Before writing in the answer book, please see that it is complete. In case there are any missing pages, it should be got replaced.

Do not tear out any pages from the Answer Book. If you use more than one Answer Book, indicate on the cover of first Answer Book the total number of Answer Books used. Do not leave any blank, unused spaces between answers. If such spaces are left, score them out.

5. Answers in excess of prescribed number will be ignored

The candidate must attempt questions strictly in accordance with the directions given on each question paper. If questions are attempted in excess of the prescribed number only the questions attempted first upto the prescribed number shall be valued and the remaining answers will be ignored.

6. Questions relating to graph/précis should be attempted only on graph/précis sheets to be supplied on demand by the Invigilators. All loose sheets such as précis sheet, drawing papers, graph sheets etc. whether used or not, should be placed inside the answer books and fastened along with the additional answer book(s), if any. Candidates who fail to observe this instruction will be penalized. Do not write your roll number on these sheets.

7. Unfair means strictly prohibited

Do not copy from the papers of any other candidate nor allow your papers to be copied nor give nor attempt to give nor obtain nor attempt to obtain irregular assistance of any description. It will be responsibility to every candidate to ensure that his/her answers are not copied by another candidate. Failure to do so will invite penalty, as may be awarded by the Commission for adoption of unfair means.

8. Conduct in Examination Hall

Do not misbehave in any manner or create disorderly scene in the examination hall or harass or bodily harm the staff deployed for the conduct of examination. You will be severely penalized if you attempt to do so.

9. Please read carefully and abide by the instructions printed on the Question Paper and on the Answer Book supplied in the Examination Hall.

Appendix – IV

Certificate regarding physical limitation in an examinee to write

This is to certify that, I have examined Mr./Ms./Mrs………………………….. (name of the candidate with benchmark disability), a person with ……………………….. (nature and percentage of disability as mentioned in the certificate of disability), S/o/D/o……………………., a resident of ……………………………….. (Village/District/State) and to state that he/she has physical limitation which hampers his/her writing capabilities owing to his/her disability.

Signature

Chief Medical Officer/Civil Surgeon /

Medical Superintendent of a Government Healt Care Institution.

Note: Certificate should be given by a specialist of the relevant stream/disability (eg. Visual Impairment – Ophthalmologist, Locomotor disability – Orthopaedic specialist/PMR).

Appendix - V

Letter of Undertaking for Using Own Scribe

(To be filled by the candidates online to the Commission)

I…………………., a candidate with………………………(name of the disability) appearing for the …………………. (name of the examination)………………. bearing Roll No………………. at ………. (name of the centre) in the District …………………., ……………… (name of the State). My qualification is ………….

I do hereby state that …………………………… (name of the scribe) will provide the service of scribe/reader/lab assistant for the undersighned for taking the aforesaid examination.

I do hereby undertake that his qualification is …………………… In case, subsequently it is found that his/her qualification is not as declared by the undersigned and is beyond my qualification, I shall forfeit my right to the post and claims thereto.

(Signature of the candidates with Disability)

Place:

Date: